W. D. Henderson

University of Texas Bulletin

No. 2710: March 8, 1927

THE GEOLOGY OF COOKE COUNTY, TEXAS

BY

H. P. BYBEE AND FRED M. BULLARD

and

PETROLEUM DEVELOPMENTS IN COOKE COUNTY

BY

E. M. HAWTOF

Bureau of Economic Geology

J. A. Udden, Director E. H. Sellards, Associate Director

PUBLISHED BY
THE UNIVERSITY OF TEXAS
AUSTIN

Publications of the University of Texas

Publications Committees:

The University publishes bulletins four times a month, so numbered that the first two digits of the number show the year of issue, the last two the position in the yearly series. (For example, No. 2201 is the first bulletin of the year 1922.) These comprise the official publications of the University, publications on humanistic and scientific subjects, bulletins prepared by the Division of Extension, by the Bureau of Economic Geology, and other bulletins of general educational interest. With the exception of special numbers, any bulletin will be sent to a citizen of Texas free on request. All communications about University publications should be addressed to University Publications, University of Texas, Austin.

UNIVERSITY OF TEXAS PRESS, AUSTIN

University of Texas Bulletin

No. 2710: March 8, 1927

THE GEOLOGY OF COOKE COUNTY, TEXAS

BY

H. P. BYBEE AND FRED M. BULLARD

and

PETROLEUM DEVELOPMENTS IN COOKE COUNTY

BY

E. M. HAWTOF

Bureau of Economic Geology

J. A. Udden, Director   E. H. Sellards, Associate Director

PUBLISHED BY THE UNIVERSITY FOUR TIMES A MONTH, AND ENTERED AS SECOND-CLASS MATTER AT THE POSTOFFICE AT AUSTIN, TEXAS, UNDER THE ACT OF AUGUST 24, 1912

The benefits of education and of useful knowledge, generally diffused through a community, are essential to the preservation of a free government.

Sam Houston

Cultivated mind is the guardian genius of democracy. . . . It is the only dictator that freemen acknowledge and the only security that freemen desire.

Mirabeau B. Lamar

CONTENTS

LIST OF ILLUSTRATIONS

Text Figures

Plates

(Figures 2 and 3 and Plates II to X, inclusive, are reproduced in this bulletin through the courtesy of the Oklahoma Geological Survey, Charles N. Gould, Director.)

THE GEOLOGY OF COOKE COUNTY, TEXAS[1]

BY H. P. BYBEE AND FRED M. BULLARD

INTRODUCTION

LOCATION

Cooke County is located in the extreme north-central part of Texas. It is one of the border counties of Texas, Red River forming its northern boundary. It is bounded on the west by Montague County, on the south by Wise and Denton counties, and on the east by Grayson County. Gainesville,

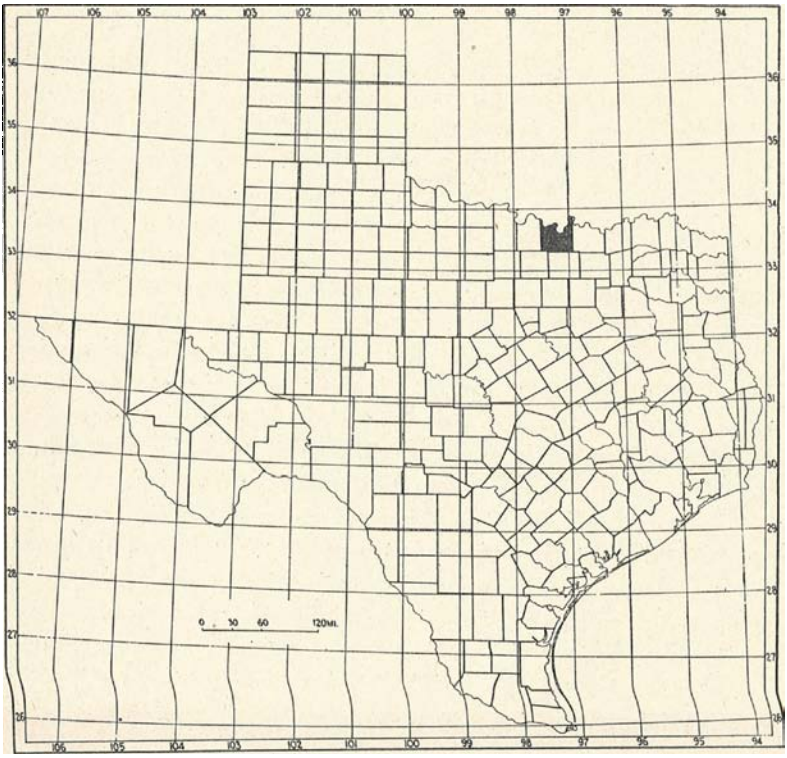


Fig. 1. Index map of Texas indicating in black the location of Cooke County.

[1]Manuscript submitted June, 1927; printed January, 1928.

located about seventy-five miles north of Fort Worth, is the largest city and the county seat. The main line of the Gulf, Colorado & Santa Fe Railroad runs north and south through the county. The Wichita Falls branch of the Missouri, Kansas & Texas Railroad passes in an east-west direction across the county. Cooke County has an area of approximately one thousand square miles.

FIELD WORK

The field work upon which this report is based was done during the summer of 1924. The Department of Geology of the University of Texas offers a course in field geology which is given each summer from about June 10 until September 1. An area is selected for study and the advanced students are given an opportunity to do actual field work. During the summer of 1924 Cooke County was selected as the region to be studied. The senior author of this report was in charge of the work, assisted by the junior author. The work consisted chiefly in mapping the areal geology, the measuring of detailed sections and the determination of the structure. There is an excellent topographic map of the Gainesville quadrangle, which includes most of Cooke County. A small part of the county is included in the Denison quadrangle, which adjoins to the east, while at the south is a small unmapped strip. A photographic enlargement of the Gainesville topographic sheet on a scale of two inches to the mile was used, and was found to be an excellent base for mapping the areal geology. The strip along the southern side of the county, not included in the Gainesville quadrangle, was surveyed and a base map constructed. The work for the most part was done by the students of the geology camp. This work was, however, carefully supervised and checked so that the report is believed to be reasonably complete.

ACKNOWLEDGMENTS

Too much credit cannot be given the students of the University of Texas Geology Camp for the excellent work

they did on the geology of Cooke County. The following students were members of the camp for the entire period of twelve weeks: Archibald Maley, G. E. Easley, S. O. Burford, Robert Cuyler, David Harrell, J. T. Printz, Eugene Murchison, Edward Pressler, Reed Christner, Randolph Wheless, J. B. Lovejoy. The following students were members of the camp for six weeks: P. J. Still, William Moore, Arthur Graydon, C. P. Craighead, C. P. Bordages, William Pierson, William Blackburn, Henry Schweer, Ernest Funkhouser.

The chapter on structure was written by the senior author, while the remainder of the report was written by the junior author. The drafting of the geologic map was done by Mrs. Bess Mills-Bullard. The structure sections accompanying the geologic map were drafted by Mr. W. B. McCarter.

LITERATURE

The principal publication dealing with this region is the Twenty-first Annual Report of the United States Geological Survey, "Geology and Geography of the Black and Grand Prairie," by R. T. Hill. This report was written in 1901 and has been the standard work on the Cretaceous of North Texas for twenty-five years. This report has been out of print for a number of years and in order to make the information available the portions of the report pertaining to Cooke County will be quoted direct.

The principal publications relating to the geology of the area discussed in the present report are given below in chronologic order.

Shumard, B. F., Notes upon the Cretaceous Strata of Texas. St. Louis Acad. Sci., Trans., Vol. I, pp. 582–610, 1860.

Taff, J. A., and Leverett, S., Report on the Cretaceous Area North of the Colorado River. Geol. Surv. Texas, 4th Ann. Rept., pp. 239–354, 2 maps, 1 plate, 1893.

Hill, R. T., On the Occurrence of Artesian and Other Underground Waters in Texas, Eastern New Mexico, and Indian Territory West of 97th Meridian. 52d Cong., 1st sess., S. Ex. Doc. 41, pt. 3, pp. 41–166, 19 pls., 1893.

Hill, R. T., Geology of Parts of Texas, Indian Territory, and Arkansas Adjacent to Red River. Geol. Soc. Amer. Bull., Vol. V, pp. 297–338, pls. 12, 13, 1894.

Hill, R. T., and Vaughan, T. W., The Lower Cretaceous Grypheas of the Texas Region. U. S. Geol. Surv. Bull. 151, 139 pp., 35 pls., 1898.

Hill, R. T., Physical Geography of the Texas Region. U. S. Geol. Surv. Top. Atlas, folio 3, 12 pp., 11 pls., 1900.

Hill, R. T., Geography and Geology of the Black and Grand Prairies, Texas. U. S. Geol. Surv., 21st Ann. Rept., pt. 7, 666 pp., 71 pls., 1901.

Taff, J. A., Chalk of Southwestern Arkansas. U. S. Geol. Surv., 22d Ann. Rept., pt. 3, pp. 687–742, pls. 47–53, 1902.

Taff, J. A., Atoka Folio (No. 79). U. S. Geol. Surv. Geol. Atlas, 8 pp., 4 maps, 2 columnar section sheets, 1902.

Taff, J. A., Tishomingo Folio (No. 98). U. S. Geol. Surv. Geol. Atlas, 8 pp., 3 maps, 1 columnar section sheet, 1903.

Veatch, A. C., Geology and Underground Water Resources of Northern Louisiana and Southern Arkansas. U. S. Geol. Surv. Prof. Paper 46, 422 pp., 51 pls., 1906.

Gordon, C. H., The Chalk Formations of Northern Texas. Am. Jour. Sci., 4th ser. vol. 27, pp. 369–373, 1909.

Taff, J. A., and Reed, W. J., The Madill Oil Pool, Oklahoma. U. S. Geol. Surv. Bull. 381, pp. 504–513, 1910.

Gordon, C. H., Geology and Underground Waters of Northeastern Texas. U. S. Surv., Water Supply Paper 276, 78 pp., 2 pls., 1911.

Hutchison, L. L., Preliminary Report on Rock Asphalt, Asphaltite, Petroleum, and Natural Gas in Oklahoma. Okla. Geol. Surv., Bull. 2, 1911.

Buttram, Frank, The Glass Sands of Oklahoma. Okla. Geol. Surv., Bull. 10, 1913.

Shannon, C. W., and others, Petroleum and Natural Gas in Oklahoma. Okla. Geol. Surv., Bull. 19, pt. 2, pp. 316–321, 1917.

Stephenson, L. W., Contribution to the Geology of Northeastern Texas and Southern Oklahoma. U. S. Geol. Surv., Prof. Paper 120, pp. 129, 1918.

Adkins, W. S., and Winton, W. M., Paleontological Correlation of the Fredericksburg and Washita Formations in North Texas. Univ. Texas Bull. 1945, 1919 (1920).

Adkins, W. S., The Weno and Pawpaw Formations of the Texas Comanchean. Univ. Texas. Bull. 1856, 1920.

Bullard, Fred M., Geology of Love County, Oklahoma. Okla. Geol. Surv., Bull. 33, 1925.

Winton, W. M., The Geology of Denton County, Texas. Univ. Texas Bull. 2544, 1926.

Bullard, Fred M., Geology of Marshall County, Oklahoma. Okla. Geol. Surv., Bull. 39, 1926.

PHYSIOGRAPHY

The entire area of Cooke County forms a part of the large physiographic province of North America known as the Gulf Coastal Plain. The Gulf Coastal Plain borders the Gulf of Mexico as a broad belt of sands, clays, and limestones, having a gentle slope toward the Gulf. The belt covers a large area in Mexico, in the southeastern half of Texas, the southeastern tier of counties in Oklahoma, all of Louisiana and Mississippi, the southern part of Alabama and Georgia, all of Florida, and merges into the Atlantic Coastal Plain province, which borders the Atlantic Ocean from Florida to New Jersey.

The strata bordering the Gulf of Mexico all dip gently toward the Gulf. The youngest, or those most recently deposited, occur at the water's edge; the oldest, namely the Trinity sand, is found outcropping farthest north, and all intermediate formations from the youngest to the oldest may be found in their proper places except as locally affected by structural features farther and farther from the water's edge, outcropping as concentric belts around the Gulf of Mexico.

DRAINAGE AND TOPOGRAPHY

Cooke County lies near the northern border of the Gulf Coastal Plain and may be described as a dissected Coastal Plain upland. The elevation ranges from 1,200 feet above sea level in the northwestern part of the county to 600 feet where Red River leaves the county on the east. Red River, which forms the northern boundary and the drainage basin for the northern half of the county, flows with a sinuous course in a southeasterly direction; it has cut a broad valley some 200 to 300 feet below the general level of the surrounding country. The gradient of Red River is very slight, averaging about 1.5 feet per mile over its extent along Cooke County.

A rather well defined divide running in a northwesterly direction beginning just to the north of Gainesville separates the drainage of Cooke County, the northern side flowing directly into Red River through a number of small creeks, of which Fish Creek is the most important. The southern part of Cooke County is drained by a number of creeks, of which Elm Creek is the largest, flowing southward into the Trinity River.

The topography of a dissected region is determined chiefly by the character of the underlying rock. On this basis the northern part of Texas has been separated[2] into a number of distinct physiographic provinces, which are also fairly distinct geologic units. The following are represented in Cooke County: (1) The Western Cross Timbers, or the area covered by the outcrop of the Trinity sand; (2) The Grand Prairie, or the area underlain by the limestones and shaly clays of the Comanchean lying above the Trinity sand; (3) The Eastern Cross Timbers, or the area covered by the outcrop of the Woodbine sand.

The Western Cross Timbers is represented in Cooke County by a rather broad area extending along the western boundary of Cooke County. It is characterized by a rolling to hilly topography with a very sandy soil, covered by a thick growth of scrub oak and black jack timber.

Above the Trinity sand are several hundred feet of alternating beds of clays and limestones which form a rolling upland prairie called the Grand Prairie. Practically the entire central part of Cooke County, extending from the Red River on the north to the southern boundary of the county, is included in this division. It has a rolling to hilly surface, upon which the indurated layers tend to produce small escarpments and benches. The most prominent of these indurated or escarpment forming ledges are in ascending order: (1) Goodland limestone, (2) Lower Duck Creek limestone, (3) Fort Worth limestone, (4) "Quarry" limestone, and (5) Main Street limestone.

The Eastern Cross Timbers, or the area covered by the outcrop of the Woodbine sand, is represented along the eastern boundary by a belt some five or six miles in width extending practically the full length of Cooke County. The topography of the Eastern Cross Timbers, while similar to

---

[2]Hill, R. T., "Geology and Geography of the Black and Grand Prairies, Texas." U. S. Geol. Surv., 21 Ann. Rept., pt. 7, 1901.

that of the Western Cross Timbers, is more rugged and hilly. The hills are due to large masses of iron segregations protecting the strata, while the unprotected area is rapidly worn away. The area is covered by a dense growth of timber, consisting chiefly of post oak and black jack.

STRATIGRAPHY

CRETACEOUS SYSTEM

COMANCHE SERIES

The Comanchean rocks consist of sands, shaly clays, marls, and limestones. They form a total thickness averaging about 1,000 feet in Cooke County. Overlying the Comanchean, and probably separated from it by a slight unconformity, is the Woodbine sand. The Woodbine sand is the youngest formation outcropping in Cooke County except recent alluvial and terrace deposits along Red River.

THE STRATIGRAPHIC COLUMN IN COOKE COUNTY

Recent		Alluvial and terrace deposits
Cretaceous (Gulf Series)		Woodbine sand
Comanche Series	Washita	Grayson marl
		Main Street limestone
		Pawpaw sand
		Weno clay
		Denton clay
		Fort Worth limestone
		Duck Creek formation
		Kiamichi clay
	Fredericksburg	Goodland limestone
	Trinity	Trinity sand

TRINITY SAND

The Trinity sand was named by Hill[3] from the Trinity River of central Texas, where the formation is well exposed.

[3]Ark. Geol. Surv., Ann. Rept. for 1888, Vol. 2, pp. 116–152, 176–179, 1888.

The Trinity sand represents the near-shore or beach deposit of the Comanchean sea, which transgressed upon the land from the southeast.

In its typical development the Trinity sand is a fine white to yellow pack sand, occurring in massive beds 40 to 50 feet in thickness. Scattered throughout the formation are found lentils of clay which are variable in thickness, from a few inches to 20 to 30 feet, and vary in color from yellow to purple and a mixture of variegated colors. Locally, the Trinity sand has some indurated layers which project as massive ledges and form hills and escarpments. These ledges are more prominent in the lower part of the formation. They are usually composed of a white sand which weathers a dull gray.

The Trinity sand weathers so easily, forming a mantle of loose debris covering its outcrop, that exposures which will permit a detailed section to be measured are extremely rare. From a study of well records in this region it is estimated that the Trinity sand has a thickness of from 500 to 700 feet.

The best and most complete section of the Trinity sand in this general region is along Red River, northwest of Sivells Bend. This section is north and a little west of Gainesville, Texas, at the place where the river makes a sharp bend to the northeast between Warrens Bend and Sivells Bend.

Section of Trinity Sand on Bluff Along Red River, Northwest of Sivells Bend

Goodland Limestone
Trinity Sand

	Ft.	In.
Clay, brown, finely stratified and laminated	11	9
Breccia, indurated with oyster shells	1	5
Oyster bed *Exogyra texana*	1	3
Clay, bituminous, interstratified with yellow sand	1	5
Sandstone, hard bluish	1	6
Sandstone, calcareous hard, with selenite in joints	1	4
Clay, marly, locally carbonaceous, containing an abundance of fossils	4	0
Oyster shells *Ostrea crenulimargo*	0	2
Clay, dark brown marly	0	3

	Ft.	In.
Clay, black carbonaceous	3	6
Pack sand, massive white	21	6
Shale, greenish-blue, appearing to be a lens	1	6
Pack sand, white	23	0
Sand, hard, pure white	2	0
Sand, yellowish-white to gray clay	14	6
Sand, white, pink, red to yellow	32	6
Sandstone, hard indurated masses of brown	1	0
Clay, sandy, red, purple, yellow, and white	48	0
Pack sand, white	12	0
Water level—Red River		
Total	181	7

The Trinity sand outcrops in the northwestern and western parts of Cooke County.

Farther south, in Texas, the middle portion of the Trinity sand becomes calcareous, and south of the Brazos River is separable, according to Hill,[4] in ascending order into the Basement sands, 127 feet; the Glen Rose formation, chiefly limestone, 315 feet; and the Paluxy sand, 190 feet. Still farther south, at Austin, Texas, the Paluxy sand is apparently represented by limestone in the upper part of the Glen Rose so that the Trinity division is divided into two formations; namely, the Travis Peak formation consisting of conglomerate, grit, sand, clay, and calcareous beds having a thickness of about 100 feet; and the Glen Rose formation consisting chiefly of limestone having a thickness of about 450 feet. Cooke County was throughout Trinity time a near-shore, shallow zone, so that sands were being deposited, but to the south in central Texas limestone deposits were being formed.

The Trinity sand weathers to form a rolling topography usually covered by a thick growth of scrub oak and black jack. Where it outcrops with the Goodland limestone overlying, steep escarpments and a very rugged topography are developed. Small ravines in the Trinity sand develop very narrow channels having nearly vertical sides.

---

[4]U. S. Geol. Surv. 21st Ann. Rept., pt. 7, pp. 153–154, 171, 1901.

FREDERICKSBURG DIVISION

The Trinity sand is overlain by the Fredericksburg division, which is represented in this area by the Goodland limestone. The Goodland limestone was named by Hill[5] from the town of Goodland, Choctaw County, Oklahoma, where it is well exposed.

The basal 2 to 4 feet of the Goodland limestone consists of persistent hard, thin-bedded, nodular limestone containing thin marly layers of shale. These beds were not recognized by Hill[6] in the type section at Goodland, in Choctaw County, Oklahoma. He says:

> Proceeding westward along the ancient Ouachita shoreline from Arkansas into Texas, the *Exogyra texana* beds (the Walnut clay and *Gryphea* breccia) are missing until the escarpment is reached north of Marietta, in Chickasha Nation [Love County, Oklahoma] where they first appear, thinly represented beneath the Goodland limestone.

In 1894[7] and again in 1901[8] Hill restricted the term Goodland to the massive limestone between the underlying Walnut clay, which he regarded as forming the upper part of the "Antlers" (Trinity) sand, and the overlying Kiamichi clay. In the Atoka folio[9] and again in the Tishomingo folio,[10] Taff included the Walnut clay in the Goodland, and this usage has since been adopted and followed by other writers, including those of the United States Geological Survey. Stephenson,[11] in 1918, although following the usage of Taff, advocates that the original definition of the Goodland, as given by Hill, be followed and that the Walnut clay or, as it is sometimes called, the Walnut shaly member be separated from the massive limestone in accordance with Hill's original usage.

---

[5]Geo. Soc. Amer. Bull., Vol. 2, pp. 502–514, 1891.
[6]*Ibid.*
[7]Geol. Soc. Amer. Bull., Vol. 5, pp. 303–304, 1894.
[8]U. S. Geol. Surv., 21st Ann. Rept., pt. 7, pp. 216–222, 1901.
[9]U. S. Geol. Surv. Geol. Atlas, Atoka folio (No. 79), 1902.
[10]*Ibid.*, Tishomingo folio (No. 98), 1903.
[11]Stephenson, L. W., Contribution to Geology of Northern Texas and Southern Oklahoma. U. S. Geol. Surv., Prof. Paper 120, 1918.

South of Red River, in Texas, the Walnut clay becomes thicker and assumes the importance of a formation rather than a member. Its maximum thickness is attained in the vicinity of Dallas, where it is approximately 150 feet in thickness. It then begins to thin out, and at Austin is only about 15 feet thick. Following is the description of the Walnut clay as given in the Austin folio.[12]

> *Walnut clay.*—At the top of the Glen Rose formation a bed of yellow calcareous clay always occurs, which is extremely rich in two species of oysters: *Exogyra texana* Roemer and *Gryphea marcoui* Hill and Vaughan. Its thickness is from 10 to 15 feet. This is an extremely persistent bed both in its lithologic and its paleontologic characters. To it the name of Walnut clay has been given. Above these clays is a soft chalky limestone, the Comanche Peak limestone.

The writers believe that the Walnut clay is not represented by this lower bed of the Goodland limestone as previously stated, but that the equivalent of the Walnut clay is another horizon still lower in the section. In the section of the Trinity sand and overlying Goodland limestone measured along the south bank of Red River north of Gainesville, a yellowish marly clay carrying an abundance of fossils, including *Exogyra texana* and *Gryphea marcoui*, was found at about 20 feet below the base of the Goodland limestone, previously described as the Walnut shaly member. (See section of Trinity sand given on p. 12, and the section of the Goodland limestone, which overlies the Trinity in practically a vertical cliff at the same location, on p. 17.) The writers do not think that there is any justification for separating this bed from the massive limestone above, for the lower bed grades into the typical massive Goodland limestone and is essentially a part of that formation. The Walnut clay equivalent, in the opinion of the writers, is represented by this marly clay zone approximately 4 feet in thickness on Red River north of Gainesville. About 30 miles south of Red River on the southern boundary of

[12]Hill, R. T., and Vaughan, T. W., U. S. Geol. Surv. Geol. Atlas, Austin folio (No. 76).

Cooke County, Texas, the Walnut clay has attained a thickness of approximately 25 feet, and occupies a position immediately beneath the Goodland limestone.

GOODLAND LIMESTONE

The Goodland limestone consists of from 20 to 30 feet of hard, white semi-crystalline limestone, which weathers almost pure white. It is massively bedded, there being as a rule about four beds ranging in thickness from 4 to 6 feet each. The lower part of the Goodland limestone is slightly chalky, but the upper part is a very hard, pure, white limestone. A peculiar characteristic of the upper part of the Goodland is that of breaking or scaling off in thin plates. This gives an exposure of the limestone a more or less shattered appearance.

The Goodland thickens somewhat to the south, containing some clay layers separating the limestone beds near the top of the formation. Along the southern boundary of Cooke County the Goodland attains a thickness of about 35 feet.

Section of the Goodland Limestone Below Bridge on Elm Creek 2 Miles South of Myra, Cooke County, Texas

Kiamichi Clay
Goodland Limestone

	Ft.	In.
Hard massive limestone, white to gray, contains *Turritella* sp., *Gryphea* sp., and *Schloenbachia acutocarinata*	6	0
Alternating beds of blue shale and soft gray limestone, which form terraces near the top of the Goodland	2	6
Massive, bluish-white, hard limestone—very fossiliferous	2	6
Blue shale	0	6
Massive limestone weathering into small angular fragments. Many large *S. acutocarinata*	4	6
Soft yellow calcareous clay containing *Grypheas* and small *Exogyras* resembling *E. plexa*	0	1
Massive gray limestone weathering into angular fragments and some small *S. acutocarinata*	4	0
Blue shale and brown clay	0	6
Light gray limestone containing numerous shell fragments including *Gryphea* and *Neithea*	2	4

	Ft.	In.
Yellow arenaceous irregular limestone. Few fossils	0	4
Hard, massive bluish-gray limestone, containing echinoids, *Gryphea, Pecten, Turritella*	6	3
Gryphea agglomerate	0	1
Massive limestone weathering into large irregular fragments containing yellow spots on weathered surface. Many fossils	2	3
White to blue sandy shale, few Grypheas	0	10
Light yellow nodular limestone having large *Pinna, Neithea, Gryphea,* echinoids, *Tylostoma,* and gastropods	2	6
Yellow argillaceous, nodular limestones having *Gryphea* and *Turritella* in great abundance; also contains *Artica,* echinoids, and a large *Ostrea*	2	0
Nodular blue sandy limestone resting directly upon blue-yellow (Walnut) clay	0	10
Total	38	2

It is a noticeable feature that along the northern boundary of Cooke County the shale or clay partings, especially in the upper part of the Goodland limestone, are practically absent and the thickness of the Goodland rarely exceeds 25 feet. However, farther south the clay partings become thicker and as a result the total thickness of the Goodland approaches 40 feet.

Section of Goodland Limestone on Bluff of Red River 2¼ Miles Down Stream from Burneyville Ferry

	Ft.	In.
Kiamichi Clay	34	2
Goodland Limestone		

	Ft.	In.
Marly white limestone	4	3
Marly clay	0	2
Massive white limestone	3	5
Marly clay	0	1
Massive white limestone	1	0
Marly clay	0	1
Massive white limestone	2	0
Marly clay	0	1
Massive white limestone	3	0
Marly nodular limestone	0	9

	Ft.	In.
Massive white limestone	5	10
Nodular shaly limestone	4	0
Trinity sand (for section, see p. 12).		
Total	24	8

This section was measured at the point where the river makes a sharp bend to the northeast between Warrens Bend and Sivells Bend. A section of the Goodland limestone measured five miles east of Sivells Bend gave a total thickness of 32 feet. The *Exogyra plexa* horizon was 2 feet 4 inches from the top and the *Gryphea* horizon 9 feet from the base. Another section of the Goodland limestone measured at the west end of Nubbin Ridge gave a total thickness of 31 feet.

The Goodland outcrops, as a rule, in a narrow sinuous band. It is distributed over a large part of western Cooke County, due to the fact that the dip of the rocks and the slope of the country are in the same direction, which keeps the Goodland always within reach of stream erosion, so that it usually forms the banks of the streams. It frequently caps high escarpments overlooking the Trinity outcrop. These escarpments are exceptionally prominent in the northwestern portion of the county. One of the most prominent escarpments is known at Tylers Bluff.

The Goodland limestone gradually increases in thickness to the south. It is regarded as the time equivalent of the Walnut clay, the Comanche Peak and Edwards limestone of central Texas, which have a combined thickness at Austin of 300 feet.

WASHITA DIVISION

The Washita is the highest division of the Comanchean. It lies conformably upon the Fredericksburg division, and was named by Hill[13] from Old Fort Washita, Bryan County, Oklahoma.

The Washita division is composed of marine shaly clays, marls, and subordinate limestones, having a total thickness

[13]Hill, R. T., Geol. Surv. of Texas, Bull. 4, 1889.

of approximately 415 feet in Cooke County. Toward the top there is a sandy member, the Pawpaw, which is the only exception to the non-sandy character of this group. The limestones, although subordinate to the clays in thickness, form several definite horizons that contain characteristic fossils which are readily traceable throughout the area, and for this reason are of the utmost importance in determining the stratigraphic sequence and structure of the region.

The Washita division has been subdivided by Hill[14] and also by Taff.[15] The classification used in this report is essentially that given by Hill, except that several of the apparently unnecessary group terms have been omitted.

The Washita division represents the beginning of the withdrawal of the Comanchean sea which reached its maximum expanse during the preceding epoch, the Fredericksburg, when widespread deposition of limestone took place. This shallowing of the sea during Washita time is recorded in the increase of shaly material toward the top of the group and finally in the deposition of sand. The numerous sand layers found throughout the Washita group bear evidence of shallow water deposition in the form of ripple marks and cross bedding. Finally at the end of Washita time the sea retreated entirely from this region, and a short erosional interval, indicated by a slight disconformity, intervened between the Comanche series and the succeeding Gulf series.

The following subdivisions of the Washita division have been mapped in Cooke County:

Grayson marl
Main Street limestone
Pawpaw sand
Weno clay
Denton clay
Fort Worth limestone
Duck Creek formation
Kiamichi clay.

[14]U. S. Geol. Surv., 21st Ann. Rept., pt. 7, pp. 240–292, 1901.

[15]U. S. Geol. Surv. Geol. Atlas, Atoka folio (No. 79), 1902; Tishomingo folio (No. 98), 1903.

KIAMICHI CLAY

The Kiamichi[16] clay was named for the Kiamichi River in Choctaw County, Oklahoma, where the formation is typically exposed. The Kiamichi includes the sediments lying between the Goodland limestone below and the Duck Creek formation above, the lower part of which is chiefly limestone. It consists of about 35 feet of dark yellowish to green shaly clay with thin platy layers of yellow siliceous limestone lenses in the lower portion. At the top the formation is marked by two or three thin ledges of a hard, yellowish limestone made up principally of oyster shells, *Gryphea navia* Hall being the most abundant species. This *Gryphea*-bearing limestone occurs at the top of the Kiamichi clay, where it makes a small but recognizable bench. The erosion of the clay underlying the hard oyster-shell breccia cause it to slump and break off in large slabs which frequently cover the outcrop of the Kiamichi. Some of the slabs may finally come to rest standing on edge or making various angles from horizontal to vertical. They are commonly referred to by the layman as "edge rock."

The contact between the Goodland limestone and the Kiamichi clay is usually marked by a rather persistent bench, caused by the erosion of the soft clay overlying the hard limestone. This contact is not a gradation, but more of a sharp break from the pure limestone to the typical clay of the Kiamichi. Usually a few inches of a brown siliceous limestone can be noticed at the base of the Kiamichi which represents the transition from the Goodland limestone to the Kiamichi clay.

The Kiamichi outcrops usually on the slopes above the Goodland escarpment, or on the sides of hills capped by the lower Duck Creek limestone. Since the Kiamichi lies between two relatively hard escarpment-forming limestones its outcrop is rather narrow and tortuous. Its outcrop is about the same as that of the Goodland limestone, being limited to the western half of the county.

---

[16]Hill, R. T., Geol. Soc. Amer. Bull., Vol 2, pp. 503, 515, 1891.

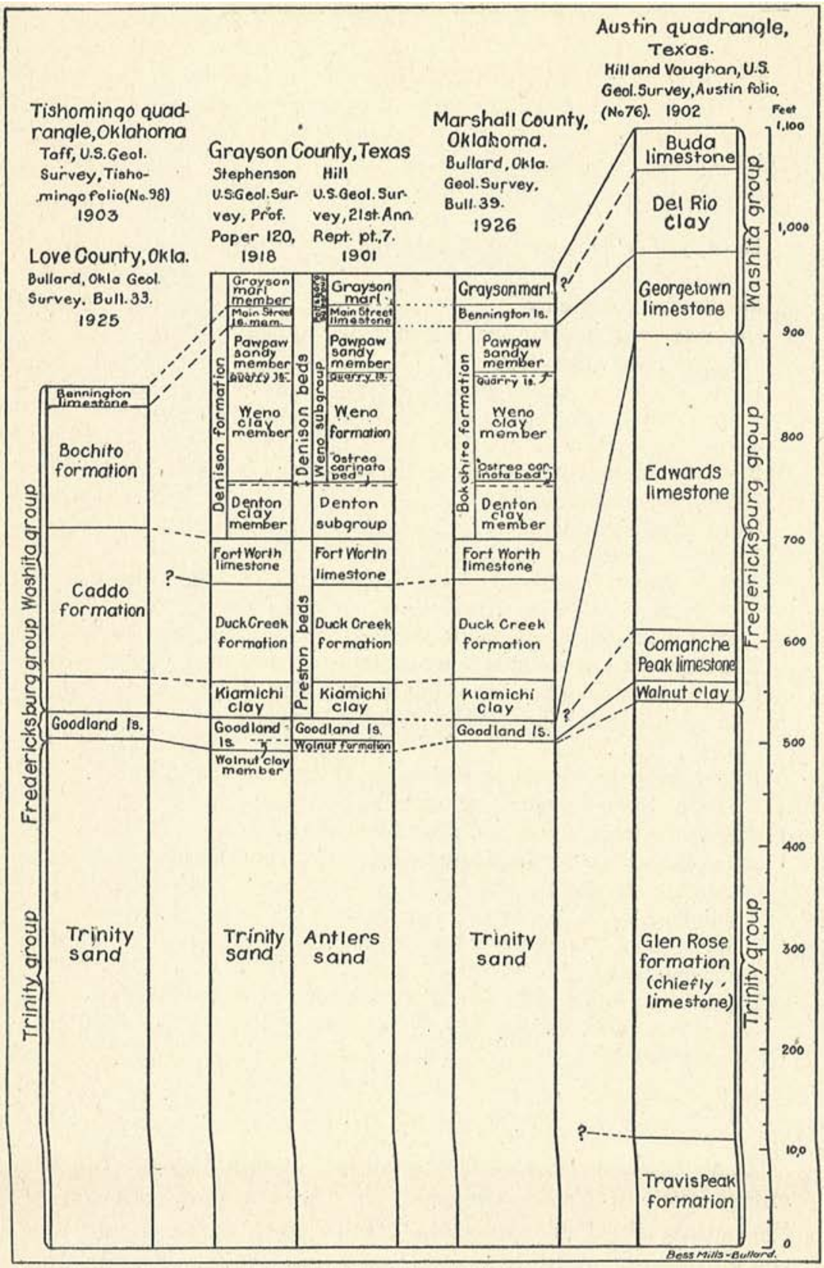


Fig. 2. Correlation table showing the relation of the subdivisions of the Comanchean in Oklahoma and Texas.

Section of Kiamichi Clay on Elm Creek, Between Myra and Lindsay, Cooke County, Texas

Duck Creek Formation
Kiamichi Clay

	Ft.	In.
Hard, yellowish-brown shell limestone, filled with *Gryphea navia*	0	3
Calcareous shaly clay	1	13
Gryphea conglomerate, not as hard as top bed	0	6
Covered (probably clay)	13	0
Hard calcareous clay ledges carrying much shell breccia and numerous *Gryphea sp.* Small amount of selenite at top and bottom	0	8
Black carbonaceous shale carrying numerous *Trigonia* sp. and much marcasite	4	0
Gray shell breccia	0	1
Black carbonaceous shale	1	2
Alternating beds of sand, shale, and selenite, 2" sand layer at the top. First sandstone layer has many fragments of shell including many small *Gryphea*	0	9
Black carbonaceous shale weathering grayish-yellow	3	1
Fissile sandstone showing ripple marks, few *Trigonia* sp., and many small pelecopods. Also a few marcasite nodules	0	5
Black carbonaceous shale with some thin sandstone layers and a few marcasite nodules	2	10
Gray calcareous sandstone showing mud cracks	0	6
Black carbonaceous, laminated clay shale showing signs of iron and ½" layers of selenite at top and also one in the middle. Shale contains many calcite crystals between lamination. Many marcasite concretions, also imprints of *Trigonia* sp.	8	0
Black sandy shale with ½" layer of sandstone at top which carries a few fossils	0	6
Goodland limestone		
Total	36	9

The above section of the Kiamichi is not typical for the entire area of Cooke County. In the northern portion of the county the thin sandstone layers seem to be absent and the clay is not as highly carbonaceous. Another point that has been noted, although its significance is not clearly understood, is that in the southern part of the county where the

Goodland limestone is greatly increased in thickness the Kiamichi clay is relatively thin. Sections have been noted in which this formation is estimated not to exceed 20 feet in total thickness.

DUCK CREEK FORMATION

The Duck Creek formation, which is typically exposed on Duck Creek north of Denison in Grayson County, Texas, consists of approximately 100 feet of limestone and gray to bluish shaly calcareous clay which intervenes between the Kiamichi clay below and the Fort Worth limestone above. In the lower 30 to 40 feet of the formation the limestone and shaly clay layers alternate in beds averaging from 6 to 12 inches in thickness in about equal proportion; in the upper 50 to 60 feet of the formation the clay greatly predominates, the limestone layers becoming thinner and being separated by a greater thickness of clay.

Section of the Duck Creek formation.—The upper Duck Creek was measured one mile west of Browns Ferry on Red River. The lower Duck Creek section was taken one-half mile southeast of Lindsay on Elm Creek.

Duck Creek Formation

	Ft.	In.
Blue clay marl with a few 3″ to 6″ limestone ledges	24	0
Calcareous sandstone	0	4
Bluish-gray clay marl	1	8
Arenaceous bluish-gray limestone	0	6
Bluish-gray shaly clay	13	6
Laminated sandstone	0	3
Bluish-gray shaly clay	8	9
Blue clay marl with thin limestone beds, containing many large *Desmoceras brazoense*	4	0
Bluish-gray marl containing many echinoids, and several species of *Schloenbachia*	3	0
Creamy-white massive limestone (resembles Goodland), contains many large ammonites *(Desmoceras)* and *Inoceramus*, also large fucoids	2	0
Alternating beds of gray limestone and clay shale containing many large ammonites *(Desmoceras brazoense)* *Schloenbachia trinodosa*, *Inoceramus*, and *Gryphea*	5	0

	Ft.	In.
Gray calcareous shale	0	9
Soft bluish-white limestone, containing *Hamites*, *Inoceramus*, and *Schloenbachia*	1	1
Gray calcareous laminated shale with some iron concretions	0	9
Bluish-white limestone containing many *Hamites*, *Inoceramus*, *Schloenbachia*, and fucoids	0	8
Blue shale	0	2
Bluish-white limestone containing *Hamites* and *Inoceramus*	0	6
Blue calcareous shale with bluish-white limestone nodules	1	6
Soft blue limestone with thin layers of shale. Contains many fossils, *Hamites*, *Schloenbachia*, *Exogyra plexa*, *Inoceramus* sp.	1	4
Dark blue shale with 1" shell breccia, also marcasite nodules	0	10
Gray jointed limestone containing many *G. navia* and *Schloenbachia* sp.	0	6
Laminated black shale, very fossiliferous, *Gryphea*, *Exogyra plexa*, and other species	0	6
Gray, soft limestone contains many *Gryphea* sp., *Schloenbachia* sp., *Inoceramus*, sp.	0	4
Black shale containing *Exogyra plexa*, *Trigonia* sp., *Gryphea navia*	0	5
Soft grayish-blue limestone	1	0
Kiamichi clay—Hard *Gryphea navia* conglomerate.		
Total	73	4

It is believed that the above section does not represent a complete section of the Duck Creek formation.

The following section by Stephenson[16a] is typical of the formation:

Section on Duck Creek and in a Cut of the St. Louis & San Francisco Railroad 2¾ Miles North of Denison, Grayson County, Texas

	Ft.	In.
Fort Worth Limestone		
Limestone, nodular, impure, argillaceous, and fossilerfous, in four or five layers, interbedded with gray shaly clay	8	0
Duck Creek Formation		
Clay, gray shaly calcareous, with interbedded layers of impure non-ledge-forming limestone at intervals of 2 to 3 feet	22	0

[16a] Stephenson, L. W., U. S. Geol. Surv. Prof. Paper 120, p. 139, 1918.

	Ft.	In.
Concealed	22	0
Clay, greenish-gray calcareous from which weather numerous specimens of *Plicatula* cf. *P. incongrua* Conrad and small rusty ammonites, probably young *Pachydiscus* and *Schloenbachia*, also a few specimens of *Gryphea washitaensis* Hill	15	0
Limestone, ledges with interbedded layers of gray shaly clay, poorly exposed; the limestone, especially one layer near the top, contains numerous keeled and non-keeled ammonites, many of which are of large size (maximum, 2 feet in diameter)	2	0
Limestone and gray shaly clay, in alternate beds, ammonite-bearing, well exposed in bluff along the creek	20	0
Total	97	0

Much confusion has resulted as to the thickness of the Duck Creek and overlying Fort Worth limestone by the placing of the contact of these two formations at different places by various investigators. There is no sharp break between these two formations, but a gradual gradation from marl or clay into a marly limestone. In the upper part of the Duck Creek thin beds of limestone, varying from one-half inch up to two or three inches in thickness occur, separated by several feet of marly clay. These limestone beds gradually become thicker and more numerous and the marly clay beds thinner until the formation become dominately limestone. With the shifting of the contact first one way and then another, the thickness of the Duck Creek and Fort Worth vary accordingly. However, the total thickness of the two formations is fairly constant, so that by comparing the thicknesses given for the Duck Creek and Fort Worth it is possible to account for the variation in the thickness of the individual formations as recorded by different authors.

The lower part of the Duck Creek contains an abundance of well preserved fossils. The large ammonite, *Desmoceras brazoense*, occurs at the top of the series of alternating limestone and shaly clay layers in the lower part of the Duck Creek formation. About thirty feet above the *Gryphea*-bearing limestone at the top of the Kiamichi clay there is a massive white limestone bed which averages about two feet in thickness. It is a very persistent bed and is the most prominent ledge in the lower Duck Creek. In its unweathered appearance this bed resembles the Goodland limestone. The large ammonites above referred to occur in this limestone ledge and also in the shaly clay directly above and below it. They are limited in vertical range to a zone probably not more than four or five feet in thickness. For this reason this "large ammonite" horizon is an excellent key bed for the determination of structure. Below the "large ammonite" horizon there is an abundance of fossils, including *Inoceramus commancheanus, Hamites fremonti, Hemiaster whitei, Schloenbachia trinodosa,* and many others which will be found listed under the Duck Creek formation in the chapter on paleontology.

The upper part of the Duck Creek is practically barren of fossils.

The Duck Creek outcrops over a broad area occupying a belt running north and south near the center of the county. The upper part of the Duck Creek, which is principally shaly clay, yields readily to weathering agencies and many of the farms and areas cultivated are those underlain by this part of the Duck Creek formation.

FORT WORTH LIMESTONE

Overlying the Duck Creek formation is the Fort Worth limestone, named from the city of Fort Worth, Texas, where it may be seen typically exposed along the streets. The Fort Worth limestone is readily separated into three parts. The lower division consists of from 10 to 15 feet of alternating beds of a yellowish-white limestone and grayish to blue shaly clay. The middle division is chiefly shale and also ranges from 10 to 15 feet in thickness. The upper division is predominately limestone, separated by thin layers of shaly clay. The limestone is a hard, cream-colored limestone, very similar to the more massive beds in the lower Duck Creek formation. The resemblance in lithologic character between the lower Duck Creek and the Fort Worth makes it difficult to distinguish the two formations except by the fossils contained therein. However the fossils are rather abundant in both of these formations, so that a few minutes search will usually reveal some fossils characteristic of one of the formations. The faunas of the Fort Worth and lower Duck Creek are quite different, there being a number of fossils characteristic of each formation and also of certain horizons in the formations. The fossils relied upon particularly to determine the Fort Worth are: *Holaster simplex, Hemiaster elegans, Schloenbachia leonensis,* and a large oyster, *Exogyra americana.* Further details regarding the fossils will be found under paleontology.

The thickness of the Fort Worth averages about 40 feet.

Following is Hill's[17] description of the Fort Worth at the type locality:

> The Fort Worth formation, as exposed in the railway cuts north of the Union Station at Fort Worth, and underlying all the business portion of that city, consists of a group of impure white limestones, very slightly arenaceous, regularly banded in persistent layers averaging nearly a foot in thickness, and alternating very regularly with similar layers of marly clay. The limestones and marls occur in strata 4 or 5 inches to 2 or more feet in thickness. The marly layers alternate with the hard limestone bands ranging from thin laminae to beds 6 inches or more thick. The gradation from hard marly bands to firm limestone is apparently sharp, but on close examination it is found to be very gradual, so that well-defined lines cannot always be clearly drawn between them. Upon weathering in vertical bluffs the hard ledges become projecting shelves and the marls form recessions between them. Before exposure the rocks are dull blue, but when weathered they are glaring white, sometimes with a slightly yellowish tinge.

Section of Fort Worth Limestone in Hampton Hollow About 2 Miles Downstream from the Toll Bridge on Red River North of Gainesville

Denton Clay (for section, see p. 31)
Fort Worth Limestone

	Ft.	In.
Yellowish-brown clay	5	0
Massive white limestone	0	8

[17] U. S. Geol. Surv., 21st Ann. Rept., pt. 7, pp. 259, 1901.

	Ft.	In.
Yellow clay	2	5
White to yellow limestone with fucoids on under surface	6	5
Bluish clay marl	2	11
Massive white to yellow limestone	0	8
Alternating beds of blue clay marl and limestone with marl predominating	19	10
Bluish clay marl	0	11
Limestone	0	4
Bluish clay marl	1	11
Limestone	1	0
Bluish clay marl	1	2
Limestone	1	0
Bluish clay marl	0	11
Limestone with large fucoids on under side	0	7
Bluish clay marl	1	11
Limestone	0	4
Bluish clay marl	0	7
Limestone with large fucoids on under side	1	0
Total	49	7

The Fort Worth limestone outcrops in Cooke County in a belt running north and south through the central part of the county. It usually forms an upland prairie which is, as a rule, too stony and rocky to be good farming land and is usually used as grazing land.

DENISON GROUP

The Fort Worth limestone passes upward into a group of sediments of various aspects laid down in shallower water and characterized by certain well-marked paleontologic zones. They are for the most part near-shore littoral deposits, some of which have no traceable, representative farther south than north-central Texas, so that arenaceous and argillaceous formations in Cooke County become limestones and marls in central Texas. This gradation may be illustrated by comparing the thickness of the Washita division in Cooke County and in central Texas, as given by Hill in the Austin folio. In Cooke County the Washita division, as previously stated, is composed chiefly of shaly clays, marls, and a subordinate amount of thin limestones with an average thickness of approximately 450 feet, while in the vicinity of Austin, Texas, the Washita division is represented by three formations—the Georgetown limestone, Del Rio clay, and the Buda limestone—having a thickness of approximately 160 feet.

Hill's description[18] of the beds which make up the Denison group, as given for the Denison area, which he states may be considered the type locality for North Texas and Indian Territory, is as follows:

> In this region it consists of laminated ferruginous clays, sandy clays, impure limestone (littoral breccia), and sand. These beds are all characterized by strong ferruginous colors peculiar to near-shore deposits, which appear only faintly, if at all, in the lower-lying Comanche series, or the extension of the Denison beds south of the Brazos, while the white chalky element is entirely absent.
>
> In the Denison section the beds consist of about 300 feet of ferruginous dark-colored clays and sands, free from the lighter-colored calcareous (chalky) element of the underlying beds, with occasional conspicuous indurated layers of impure limestone, ferruginous sandstone, iron ore, and clays, which lie between the top of the Fort Worth limestone and the Grayson marl.

Hill applied the term *Denison beds* to a portion of this series and then divided it into a number of members. Concerning this, he says:[19]

> In a general manner the Denison beds may be subdivided into three conspicuous subgroups—the lower, middle, and upper.
>
> The lower subgroup of the Denison beds, including all that portion below the top of the *O. carinata* horizon, will be generally alluded to as the Denton beds.
>
> The medial or Weno subgroup of the Denison beds, including all that portion above *O. carinata* horizon and beneath the Main Street limestone, for convenience may be divided into the Weno and Pawpaw formations. For the upper subgroup consisting of the Main Street limestone and Grayson marl, the term *Pottsboro* may be used.

---

[18] U. S. Geo. Surv., 21st Ann. Rept., pt. 7, p. 266, 1901.

[19] *Ibid.*, p. 267.

Stephenson[20] in his work accepted Hill's subdivision of the beds, but simplified his nomenclature somewhat by discarding all the subgroup terms, calling the whole series the Denison formation with the following members:

Denison Formation
- Grayson marl member
- Main Street limestone member
- Pawpaw sand member
- Weno clay member
- Denton clay member.

In Oklahoma Taff[21] grouped the beds lying below the Main Street limestone and above the Fort Worth limestone under the term *Bokchito formation.* In recent reports[22] the Bokchito has been separated into the three divisions recognized in Texas, namely, the Denton, Weno, and Pawpaw members, respectively, and the Main Street limestone and Grayson marl are described as separate formations.

In this report, in order to further simplify the nomenclature of these beds, all the unnecessary terms will be dropped and the following formations described:

- Grayson marl
- Main Street limestone
- Pawpaw sand
- Weno clay
- Denton clay.

DENTON CLAY

The Denton clay immediately overlies the Fort Worth. It is named for the city of Denton, Denton County, Texas. In Cooke County the Denton consists of from 45 to 60 feet of brownish-yellow clay with numerous sandstone beds and lenses terminating at the top with a hard, brownish-yellow arenaceous limestone containing an abundance of fossils. This fossiliferous limestone rarely exceeds one foot in thickness.

[20]U. S. Geol. Surv. Prof. Paper, 120, 1918.
[21]U. S. Geol. Surv. Geol. Atlas (Atoka folio No. 79), 1902.
[22]Bullard, Fred M., Okla. Geol. Surv., Bull. 39, 1926.

Hill[23] makes the following statement in regard to the Denton clay:

> The lower part of the Denton subgroup consists of blue marly clays, terminating above by conspicuous indurations of oyster breccia made up largely of *Gryphea washitaensis* accompanied by *Ostrea carinata.*

The lower 5 to 10 feet of the Denton is decidedly a calcareous clay. The first horizon that can be definitely recognized in the Denton clay is a sandstone bed, ranging from 1 to 2 feet in thickness. This sandstone is thinly laminated, a yellowish-brown on weathered surfaces and usually contains well developed ripple marks on its surface. This "ripple-mark" sandstone lies near the middle of the Denton, varying from 30 to 35 feet above the top of the Fort Worth. It is practically the only indurated bed in the Denton, and can usually be used to an advantage in mapping, since it is very easy to locate, as large slabs of this sandstone frequently cover the slope of a small escarpment or bench which it forms. The top of the Denton, as above stated, is marked by an impure fossiliferous limestone containing an abundance of fossils. This bed is the *"Ostrea carinata"* horizon of Hill. Along the northern boundary of Cooke County this bed is composed chiefly of *Gryphea washitaensis*, but in about the middle of the county a few *Ostrea carinata* forms appear and still farther south become very abundant.

Section of the Denton Clay as Exposed on Hampton Hollow About 2 Miles Downstream from Toll Bridge on Red River, North of Gainesville, Cooke County, Texas

Weno Clay (for section, see p. 34)
Denton Clay

	Ft.	In.
Yellowish-brown clay marl with scattered individuals of *Gryphea washitaensis*	35	4
Yellowish-brown, thinly laminated sandstone, ripple marked	1	6
Brownish-yellow marly clay with few iron nodules	30	2
Total	67	0

[23] *Ibid.*, p. 268, Hill. U. S. Geol. Surv., 21st Ann. Rept.

Hill[24] gives the following section of the Denton as measured on the bluffs of Red River at Browns Ferry, Cooke County, Texas.

Denton Subgroup
O. Carinata Beds

	Ft.	In.
Agglomerate of *G. washitaensis* with *O. carinata*, *Trigonia*, and *Schloenbachia* sp.	5	0
Soft argillaceous sand	3	0
Laminated cross-bedded sandstone	1	0
Friable laminated clay	2	6
Gervilliopsis bed	11	6
Marl with *Gervilliopsis invaginata* and *G. washitaensis*	0	6
Friable blue marl with *G. washitaensis* and *Trigonia*	25	0
Total	47	6

According to recent investigations the above section is 20 feet short, as a clay marl bed of that thickness was omitted near the top of the section.

Adkins[25] gives a section measured at the Gainesville brick pit which he regards as Weno. The following section regarded by the writers as Denton was measured at the pit of the brickyards one mile east of Gainesville:

Denton Clay
O. Carinata Bed

	Ft.	In.
Agglomerate of *G. washitaensis*, *Pecten* sp., *O. carinata*, *Leiocidaris hemigranosus*, and echinoid spines	1	0
Gray clay containing *G. washitaensis*	1	6
Gray clay and shale containing ironstone concretions	0	8
Ironstone layers containing many fossils, *Protocardia texana*, *Engonoceras serpentinum*	1	0
Gray clay and shale containing iron concretions	22	0
Gray fissile, thinly laminated sandstone, contains a few *Trigonia* sp.	1	0
Grayson clay and shale containing many fossils including *Gervilliopsis invaginata*, *Pecten* sp., *Gryphea washitaensis*, *Nucula* sp., *Protocardia texana*	20	0
Total	47	2

[24]*Ibid.*, p. 270

[25]Adkins, W. S., "The Weno and Pawpaw Formations of the Texas Comanchean." Univ. of Texas Bull. 1856, p. 36, 1918.

The Denton outcrops in a belt running north and south across the county, passing through Gainesville. It produces an upland prairie with a rich black waxy soil.

WENO CLAY

The Denton clay is overlain by a dark gray to yellow clay averaging about 100 feet in thickness. The name *Weno* was given by Hill from the village of Weno, on Red River, five miles northeast of Denison, Grayson County, Texas. The village of Weno does not appear on recent maps and apparently has been abandoned.

Following is Hill's[26] description of this member:

> This subgroup attains its maximum development in the Denison section, where it includes all the beds between the top of the *G. washitaensis* agglomerate and the top of the Quarry limestone. It is well developed in the Red River region, where its several beds are important stratigraphic units, but those lose individuality southward across the State.
>
> The Weno formation is characterized by a littoral fauna of many small species occurring in great quantities in certain horizons, notably *O. quadruplicata* and certain ammonitic forms of the *Engonoceras* type, which are now being studied by paleontologists.
>
> *Character of beds at Denison.*—In the Denison section these beds embrace several well-defined members, consisting of very ferruginous brownish marls, with occasional persistent harder beds, such as large lens-shaped segregations, beds of ferruginous sandstone, impure limestone, etc., all of which are locally persistent and some very conspicuous. The indurated beds of the Denison are interesting. One of these indurated layers, 80 feet below the summit, is especially noticeable, in as much as it consists of large lenticular indurations of a clay ironstone which are thinly laminated and break into sheets along the line of laminae. These concretions are blue interiorly and brown exteriorly, and are often 4 or 5 feet in diameter. About 22 feet below the indurations, or 104 feet below the Quarry limestone, there is another indurated bed consisting of sandstone, as exposed near the cemetery gate north of Denison. Below this, extending down to the *O. carinata* beds there are brown clay marls to a depth of about 22 feet. In the Denison section the strata of the Weno subgroup are clearly defined and easily recognizable. Southward toward Fort

[26]U. S. Geol. Surv. 21st Ann. Rept., pt. 7, p. 274, 1901.

Worth they lose their individuality, after the disappearance of the Quarry limestone in Denton County, which to the northward separates the Weno from the Pawpaw formation. Furthermore the limestone element increases proportionately until the lithologic character so changes that along the banks of the Trinity the beds somewhat resemble the underlying Fort Worth beds.

The Weno is very similar to Denton in lithologic characteristics, the principal differences being that the Weno contains more thin soft sandy layers and also many clay ironstone concretions.

Section of the Weno Clay at Hampton Hollow, About 2 Miles Downstream from the Toll Bridge on Red River North of Gainesville, Cooke County, Texas

Pawpaw Sand
Weno Clay

	Ft.	In.
"Quarry limestone"—very sandy, flaggy limestone, brownish-yellow in color—contains an abundance of *O. quadruplicata, O. subovata*	4	0
Blue to yellowish-brown clay marl contains a bed of ferruginous material carrying an abundance of *Turritella* sp. 15′ to 20′ below the "Quarry"	38	0
Light yellow flaggy limestone	1	6
Blue to brown clay marl	30	0
Soft, light yellow sandstone	0	6
Total	90	0

Hill[27] gives the following section of the Weno which was measured on the bluffs of Red River north of Gainesville:

Section of Bluffs of Red River at Browns Ferry, Cooke County, Texas

	Ft.
"Quarry limestone"	1.5
Blue laminated marl with *O. quadruplicata*	15.0
Arenaceous clay ironstone, a mass of *Turritella*	0.5
Laminated clay marl	24.5
Arenaceous yellow limestone (*O. quadruplicata*)	4.0

[27] *Ibid.*, p. 269.

	Ft.
Friable arenaceous marl	20.0
Fissile flaggy sandstone	4.0
Laminated arenaceous clay with bands of clay ironstone nodules	20.0
Arenaceous limestone with *O. quadruplicata* and *G. washitaensis*	1.0
Total	90.5

Denton Clay

The Weno is easily recognized by the larger amount of iron concretions which it contains. The top member of the Weno is the "Quarry limestone," so named because commonly quarried for use as local building stone. The name *limestone* is somewhat of a misnomer, for the typical "Quarry" is probably more of a sandstone than a limestone. Hill's[28] description of the "Quarry limestone" is as follows:

> "*Quarry limestone.*"—This is a persistent band of siliceous limestone, which is notable in the series of otherwise unconsolidated beds and is the chief building stone in the country underlain by the Denison beds. Its interior portion is steel blue in color, but it oxidizes for a depth of 2 or 3 inches from the surface into chrome yellow. Its thickness at Denison is about 1.7 feet. This is an especially conspicuous formation within the relatively limited area of its occurrence, although at no place over 2 or 3 feet in thickness. It is very arenaceous and might as well be considered a sandstone as a limestone. It is accompanied above by great quantities of the peculiar *Ostrea quadruplicata.*

One of the methods used to determine the "Quarry" is the presence of ferruginous masses of very fossiliferous material consisting chiefly of *Turritella* sp. and *Protocardia* sp. casts. These beds are usually lenticular, but are in such abundance that scattered fragments can usually be found on any slope of the upper Weno. It is notable that these ferruginous beds containing *Turritella* in abundance occur some 15 to 20 feet below the "Quarry limestone." Beds of a similar nature occur in the overlying Pawpaw but carry chiefly a small pelecypod with only an occasional *Turritella.*

[28]*Ibid.*, p. 275.

A more or less complete list of fossils found in these beds will be given under "Paleontology."

A rather persistent horizon in the Weno is formed by a sandy limestone which is rarely more than one foot in thickness. It is a very hard limestone which weathers a yellowish-white. It occurs about 30 to 40 feet below the "Quarry limestone."

The Weno weathers very easily, forming a rolling upland. For this reason it is poorly exposed and sections suitable for detailed study are difficult to find.

PAWPAW SAND

The Weno clay is overlain by 50 feet of more or less irregularly bedded sandy clays and sands extending from the "Quarry limestone" at the base to the Main Street limestone at the top. The Pawpaw here is restricted to those sediments lying between the two limestones above named. Stephenson[29] included the "Quarry limestone" with the Pawpaw, but in this report Hill's original usage, *i.e.*, considering the "Quarry" as the top of the Weno, is followed.

Following is Hill's[30] description of these beds in the Denison area:

> *Pawpaw beds.*—These include the strata between the Quarry and Main Street limestones. In the Denison section these are very impure laminated sandy clays and sands, dark blue ferruginous colors, very much like the Woodbine (Dakota) formation. They are very sandy in the upper 5 feet at the crossing of Pawpaw Creek and the Texas Central Railway. This aspect is local however. There are also small fragments of lignite in the sands and the character of the sediments seem to be favorable to the preservation of leaf impressions, but careful research up to date has failed to discover these.
>
> The Pawpaw is the most impure of all the Denison beds, and was apparently laid down near the shore, being accompanied by beds of ferruginous sand, which are not elsewhere found in the Washita division. The total thickness at Denison is 45 feet.

---

[29]U. S. Geol. Surv. Prof. Paper 120, 1918.

[30]*Ibid.*, p. 276

At the base of the Pawpaw, just above the Quarry limestone, are lead-colored shales with sandy alterations containing innumerable well-preserved calcareous shells, which in some places are replaced by pseudomorphs of iron ore. One band, just above the Quarry limestone, consists of one foot or more of impure, friable ferruginous material, containing beautifully preserved fossils. These fossils are especially abundant in the lower 12 feet and consist of littoral Mollusca of many species.

In certain clay layers the calcareous shells are preserved with all their pearly luster. In sandy layers where ferruginous percolation has taken place the shell substance is dissolved and they are perserved as casts and mounds in an arenaceous matrix of limonitic ironstone.

Section of the Pawpaw Sand[34] *in Roadside Cuts 2½ Miles Southeast of Gainesville, Texas. (Section Furnished by W. M. Winton)*

Main Street Limestone	
	Ft.
Massive white limestone	6
Pawpaw	
	Ft.
Alternating red ironstone and ferruginous sandy clay layers. About 16 compact ironstone layers each 3″ to 4″ thick, alternating with clay layers each about 1′ thick. The ironstone layers are similar from bottom to top and the basal 10 feet is more fossiliferous than the upper portion. The ironstone layers contain: *Remondia* sp., *Trigonia* sp., *Arca* sp., *Engonoceras* sp., *Nucula* sp., *Corbula* sp., and other nacerous and ironstone fossils	21.5
Brown sandstone flat layer	0.5
Red ironstone layer with *Nodosaria texana*	0.3
Brown clay	5.0
Red ironstone with *Arca* sp., *Ostrea quadruplicata*	0.5
Red clay, sparsely fossiliferous—*Arca*, gastropods	15.0
Red calcareous sandstone—*Ostrea quadruplicata*	2.0
"Quarry Limestone"	
Total	44.8

[34]Adkins, W. S., Univ. of Texas Bull. 1856, 1918.

The Pawpaw contains several thin lenses of highly fossiliferous ferruginous, oxidized, soft sandstones, which resemble the beds in the Weno, but the beds in the Pawpaw, while carrying many of the fossils found in the Weno, do not usually contain *Turritella,* while those in the Weno are composed chiefly of this gastropod.

The Pawpaw weathers forming a very sandy, ferruginous soil, the iron concretions and segregations often covering the surface. Frequently small hills are capped by a mass of limonite which has accumulated by the weathering of the Pawpaw. The Pawpaw produces a topography very similar to the Woodbine, and may be confused with it. It is usually covered by a growth of timber which stands out in marked contrast to the prairie upland of the other members of the Washita Division.

MAIN STREET LIMESTONE

The Main Street limestone, so named by Hill because it outcrops in the main street of the city of Denison, immediately overlies the Pawpaw sand. It consists of from 10 to 15 feet of heavy-bedded, brown, semi-crystalline limestone with subordinate layers of calcareous marl. As a rule the limestone beds are more massive near the base and become thinner toward the top and are separated by a greater thickness of marl. The Main Street is characterized by the presence of a peculiar ram's-horn-shaped fossil, *Exogyra arietina* Roemer, which occurs throughout the formation, but is more abundant in the upper part, and *Kingena wacoensis,* the only brachiopod of common occurrence in the Cretaceous, is found more especially in the lower portion.

Hill[32] gives the following section of the Main Street on Rock Creek in the northwestern portion of Grayson County, Texas.

---

[32]U. S. Geol. Surv., 21st Ann. Rept., pt. 7, p. 281, 1901.

Section of Main Street Limestone on Rock Creek, Northwestern Grayson County, Texas

Grayson Marl

	Ft.
Marl light yellow, with bands of limestone and great numbers of *Gryphea mucronata*, the upper portion concealed	15

Main Street Limestone

Beginning at the base with compact yellow shell limestone, and grading upward into friable marl. *Kingena wacoensis* occurs in the lower portion, while *Exogyra arietina* ranges throughout	18
Limestone, arenaceous shell, with *Ostrea quadruplicata* and *O. subovata* at the base, and *Exogyra arieitina* and *Kingena wacoensis* succeeding	5
Total	38

Pawpaw Formation

Following is Hill's[33] description of the Main Street limestone in the Denison area:

> *Main Street limestone.*—In the Red River section the Main Street limestone constitutes a very conspicuous formation, not only on account of the hardness of the strata, but because of its effect as a topographic factor. It consists of a coarsely crystalline, bedded, brecciated, white limestone, which, on oxidation, turns a deep yellow, showing much more ferruginous coloring than any of the other limestones of the Comanche series. It occurs in strata of various thicknesses. Usually there are more massive beds at the base and thinner strata at the top, with occasional sandy marl layers. The formation nowhere aggregates more than 25 feet. Taff notes a thickness of 23 feet at Rock Creek, Grayson County. At Denison 15 feet have been noted.

The Main Street limestone forms a very narrow tortuous band which runs from the northwestern corner of Cooke County in a south by southwest direction. As it occurs between the Pawpaw sand below and the Woodbine sand

[33] *Ibid.*, p. 280.

above its outcrop is sometimes completely covered and for this reason apparently not continuous.

GRAYSON MARL

The Grayson marl is the uppermost formation of the Comanchean in this region. The type exposure of the Grayson is in an abandoned cut of an old unused railroad grade in the southeast portion of Denison, Grayson County, Texas, discovered by Professor Cragin,[34] who first named the formation. The Grayson marl consists of light-colored fossiliferous clays or marls with many small lumps of lime and limestone nodules, having a total thickness of approximately 25 feet.

The lower contact of the Grayson, or its contact with the Main Street limestone, is rather difficult to determine, as it is more or less a gradation from the typical limestone into the marl. The upper contact of the Grayson is usually covered by ferruginous sandstone and other debris from the overlying Woodbine sand. In fact, in many places the marl is entirely concealed by this debris from the Woodbine sand so that it outcrops only in a few disconnected places.

The lower part of the Grayson contains an abundance of *Exogyra arietina* Roemer. Two other fossils which are characteristic of the Grayson are also found very abundantly. They are: *Gryphea mucronata* Gabb and *Turrilites brazoensis* Roemer.

Section of the Grayson Marl and Main Street Limestone as Exposed on Walnut Creek, 4 Miles East of Hemming and 1 Mile South of Bloomfield, Cooke County, Texas

	Ft.	In.
Woodbine Sand		
Sandy clay	15	0
Light yellow sand	3	0
Grayson Marl		
Alternating beds of white chalky limestone and marl.		
Very fossiliferous zone containing *Protocardia texana*,		

[34]Cragin, F. W., "Colorado College Studies," Colorado Springs, Colo., 1894, p. 43.

	Ft.	In.
Turrilites brazoensis, Gryphea mucronata, Pecten, sp., Ananchytes sp.	8	0
Gray marl	3	0
Dark shaly marl	3	0
Red iron-stained sandy marl	0	4
Gray marl	3	0
Hard crystalline limestone, shell fragments	0	4
White gray marl	12	0
White chalky limestone	1	0
White marl	1	3
Main Street Limestone		
Hard agglomerate of *Exogyra arietina*	1	1
Alternating beds of limestone and thin shale beds. Bottom of Main Street is somewhat arenaceous and on weathering turns brown while the top layers are white and chalky	12	0
Total Grayson marl	31	11
Total Main Street limestone	12	1

In mapping the Grayson marl in Cooke County it was found that due to the overwashing of the Woodbine sand the outcrops were covered in so many places that it was impractical to try to trace it out. An average width has therefore been assigned and the outcrop drawn in. So far as known the Grayson marl is present always above the Main Street limestone, but the nature of its contact with the Woodbine sand is uncertain.

GULF SERIES

WOODBINE SAND

The Woodbine sand, named by Hill[35] from the town of Woodbine in eastern Cooke County, Texas, is the basal member of the Gulf Series of the Cretaceous in this region. The Woodbine sand immediately overlies the Grayson marl and is apparently unconformable on it. In this connection Stephenson[36] makes the following statement:

> The nature of the contact separating the Gulf Series from the underlying Comanche series has not been satisfactorily

[35]U. S. Geol. Surv., 21st Ann. Rept., pt. 7, p. 243, 1901.
[36]U. S. Geol. Surv. Prof. Paper 120, p. 144, 1918.

determined in northeastern Texas. Probably it is that of an unconformity, the basal member of the upper series, the Woodbine sand, having been deposited in shallow waters of the transgressing sea, in the deeper waters of which the succeeding truly marine sediments of the series were laid down.

Hill's[37] description of the Woodbine sand is as follows:

The rocks of the Woodbine formation are largely made up of ferruginous, argillaceous sands, characterized by intense brownish discoloration in places, which are accompanied by bituminous laminated clays. These sands like those of the Trinity division (Western Cross Timbers), are consolidated in places, but differ from them by containing a greater proportion of iron and other mineral salts, which materially influence the character of the waters derived from them. The sands, which in unoxidized substructure are usually white and friable, contain particles of iron occurring as glauconite and pyrite. These minerals oxidize toward the superfacies, and their solutions consolidate the more porous beds into dark brown siliceous iron ore, occurring in immense beds in certain localities. Other beds of sand break down into deep, loose soil. These support a vigorous timber growth and are especially adapted to fruit culture. The clays are usually sandy and sometimes bituminous, although in some places, as near Denton, of sufficient purity for making stoneware. They occur either as extensive beds or as laminae and thin strata interbedded in the sands.

The presence of fossil vegetation, such as leaf impressions and lignite, distinguishes the beds of this division from the other formations of the Upper Cretaceous and attests its shallow water littoral origin.

The Woodbine sand is cross-bedded to a large extent, so that it is extremely difficult to determine the thickness from surface exposures. Stephenson[38] states that it is not less than 300 or 400 feet thick in Grayson County, Texas, and may reach a thickness of 500 feet.

The Woodbine weathers into a loose, sandy soil, mostly covered with a dense growth of post oak and black timber. It forms a rather hilly topography, the tops of the hills being covered by a mass of ferruginous material, which is so characteristic of the basal portion of the Woodbine. These

[37]U. S. Geol. Surv., 21st Ann. Rept., pt. 7, p. 294, 1901.
[38]*Ibid.*, p. 145.

segregations and veins of iron ore concentrate on the hill tops and other places due to the removal of the soft friable sand.

The Woodbine outcrops in a belt varying in width up to about seven miles along the eastern boundary of the county. The typical hilly topography characteristic of the Woodbine is well developed due east of Gainesville.

STRUCTURE

GENERAL STRUCTURAL FEATURES

The general structure of the Cretaceous in Cooke County is that of a gently dipping monocline with a slope to the south and east varying from 30 to 50 feet per mile. The strike of the Comanchean formations over the southern two-thirds of the county is almost due north and south. From a point about nine miles north of Gainesville the strike changes to a direction approaching N. 35° E. This trend continues beyond the limits of Cooke County. Over the southern two-thirds of the county the Comanchean formations dip gently to the east.

At the United States Geological Survey Bench Mark on the Missouri, Kansas & Texas Railway one mile east of the western boundary of Cooke County, the top of the Goodland limestone has an elevation of 1,150 feet above sea level. Seventeen and one-half miles slightly north of east at a point where the Gulf, Colorado & Santa Fe Railroad crosses Red River, the top of the Goodland limestone has an elevation of 650 feet above sea level. This would give an average east dip of 28.5 feet per mile. It is almost impossible to determine the exact amount of the dip of the formations east of Gainesville. However, it probably does not change to any considerable extent.

In a north-south direction there appears to be a very gentle inclination of 5.7 feet per mile to the south. At a point two and one-half miles southwest of Tyas Bend the top of the Goodland limestone stands 1,050 feet above sea level, while the top of the same formation three miles south of Hood on Flat Creek is 925 feet above sea level. The general situation may be noted by referring to the cross sections on the bottom of the geologic map.

East Texas Embayment.—This embayment has had a greater influence upon the strike or trend of the Cretaceous formations of Texas than most any other single factor. Cooke County is situated in the extreme northwestern portion of this embayment. From Cooke County south the strike of the Comanchean formations is almost due north and south. From the western part of Cooke County the strike is northeast for a distance of about 35 miles or to a point 7 miles southeast of Ardmore, Okla. From this point the strike trends a little south of east to the Arkansas boundary.

Cooke County is located approximately 40 miles due south of the Arbuckle Mountains of southern Oklahoma, which represents a portion of an old mountain system which trended in a general east and west direction across the southern portion of Oklahoma. The Arbuckle Mountains[39] came into existence during the late Paleozoic era and consist of an enormous thickness of sedimentary rocks intensely folded and faulted into a large geanticline with its axis trending N. 40° W. Following the folding of these sediments at the close of the Paleozoic era, a long erosional period occupying probably all of the Triassic and Jurassic and early portion of the Comanchean ensued, during which time the lofty mountains were reduced to a peneplain and were subsequently covered or partially covered by the Comanchean sea. It is on this folded, eroded, and peneplained surface of Paleozoic rocks that the Cretaceous sediments were deposited.

The Criner Hills,[40] in Oklahoma, located about midway between the northern boundary of Cooke County and the Arbuckle Mountains, consists of rocks of early Paleozoic age which have been intensely folded and faulted. They have been described as the Arbuckle Mountains in miniature.

[39]U. S. Geol. Surv. Prof. Paper 31, 1904.

[40]*Ibid.*

They are the nearest outcrop of Cambro-Orcovician rocks to Cooke County, being less than 15 miles north of the northern extremity.

While we have insufficient data at hand to justify a positive statement, it would appear that the Paleozoic rocks, which are found directly under the Comanchean formation, have been influenced by the Arbuckle uplift and possess similar structural features. Therefore, if structures are encountered in the upper Paleozoic rocks, it would be expected that they would have a general northwest-southeast trend conforming with the general strike of the folds in the Arbuckle Mountains and Criner Hills.[40*]

Preston Anticline.[41]—One of the major structural features of north-central Texas and central-southern Oklahoma is the Preston anticline. It is a large anticline some 30 to 50 miles in length beginning near Ardmore, Okla., and extending southeastward to a point a few miles east of Denison, Texas. The Criner Hills, previously mentioned, represent a portion of the Preston anticline where the Cretaceous covering has been removed, exposing the ancient Paleozoic core. Parallel to the Preston anticline on the north are a number of smaller structures. They are, in order of their occurrence: the Kingston syncline, the Madill anticline, and the Cumberland syncline. On the south of the Preston anticline two large synclines have been mapped—one in Love County, Oklahoma, which is immediately north of Cooke County, the Marietta syncline, and the other in Grayson County, Texas, called the Sherman syncline. It is very likely that these two synclines are continuous. No anticlines have been mapped south of these synclines, but it would seem that similar conditions should exist on the south side of the Preston anticline as are found on the north side and it is expected that detailed work will reveal the presence of a series of minor folds, striking parallel to the Preston anticline.

[40*]Since this manuscript was written a northwest-southeast structural trend has been demonstrated in the underlying Paleozoic formation. (See map.)

[41]Hopkins, O. B., Powers, Sidney, and Robinson, H. M., "The Structure of the Madill-Denison Area, Oklahoma and Texas." U. S. Geol. Surv. Bull. 736, 1922.

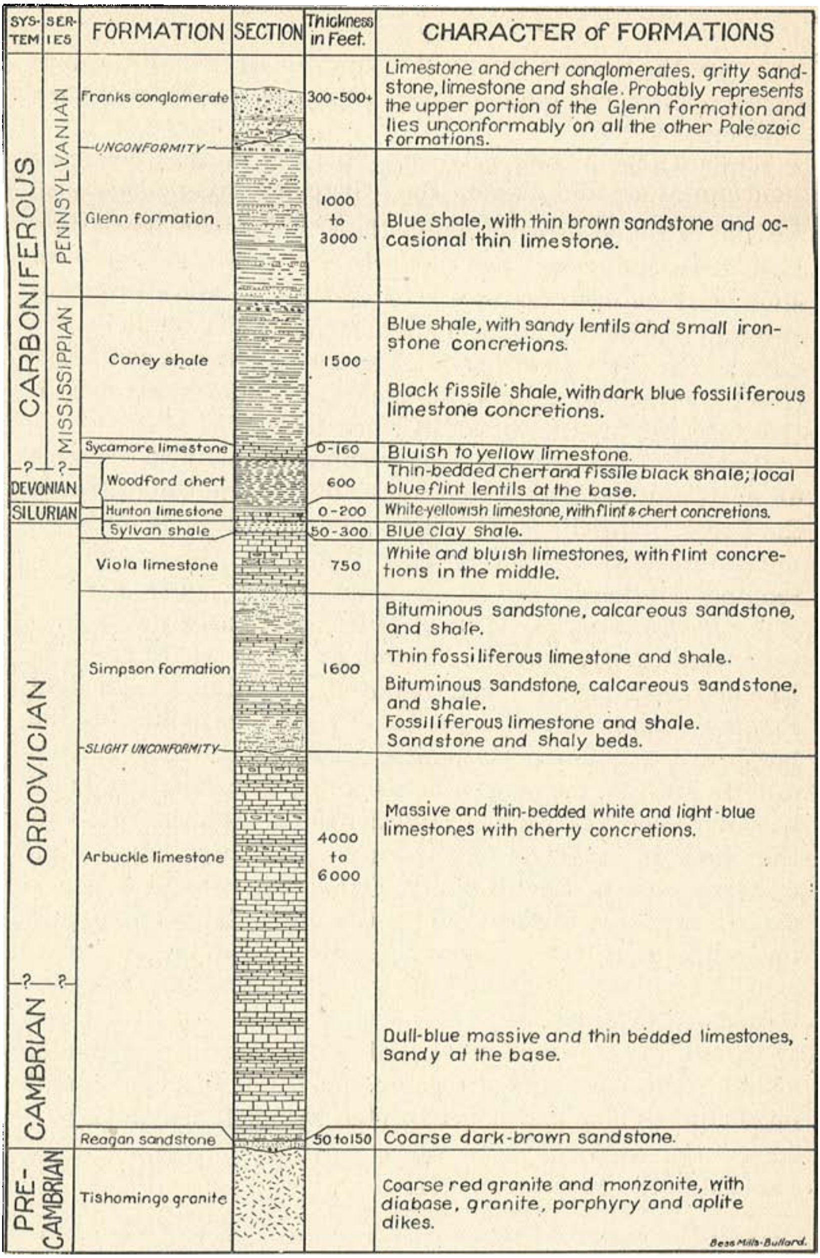


Fig. 3. Section of the Paleozoic formations exposed in the Arbuckle Mountains, from J. A. Taff, U. S. Geol. Surv., Geol. Atlas, Tishomingo folio (No. 98), 1903.

Considerable detailed plane table work was done in the vicinity of Myra, Muenster, Lindsay, and Marysville. No closed structures were found, but some indications of slight folds were noted. Elevations were run on the top of the Goodland limestone and also on the "Gryphea" conglomerate at the top of the Kiamichi formation. In Love[42] and Marshall[43] counties, Oklahoma, where the surface rocks are identical with those in Cooke County, it has been found that the major creeks are anticlinal, while a row or line of hills indicates a syncline. The same conditions are expected in Cooke County. That is a topographic high represents a structural low. Extreme care must be exercised in working structure on the Goodland limestone and also on the top of the Kiamichi formation, as slumping is a common feature in these formations and may appear to indicate structure.

KEY HORIZONS IN COOKE COUNTY

In working the structure of a region it is necessary to have some bed or horizon which extends over the area, and which can be easily recognized. In the portion of Cooke County covered by the formations lying above the Trinity sand, there are a number of excellent "key horizons." These key horizons, beginning with the oldest, are described in the following paragraphs.

Goodland limestone.—This is probably the horizon best suited for structural work. It is a most persistent horizon, outcrops over a broad area, maintains a fairly uniform thickness, and forms a sharp, easily recognized contact with the overlying Kiamichi clay. As a rule a flat terrace varying in width up to several hundred feet is found at the top of the Goodland, formed by the removal of the soft clay above.

"Oyster shell conglomerate."—This bed occurs at the top of the Kiamichi clay. It is a very easily recognized bed, but care must be used in working structure on this horizon

---

[42]Bullard, Fred M., Okla. Geol. Surv. Bull. 33, 1925.
[43]*Ibid.*, Bull. 39, 1926.

as it frequently slumps and is found covering the entire slope below.

Duck Creek formation.—There are several horizons in the lower Duck Creek which may be used as key beds, the most prominent being the "large ammonite" horizon occurring about 33 feet above the base of the Duck Creek. It is a zone about 6 to 10 feet in thickness, in which the "large ammonite" *Desmoceras brazoense* is abundant. A massive white limestone bed about two feet in thickness, occurs in the same zone as the "large ammonite." This bed is the most prominent bed in the lower Duck Creek.

Fort Worth limestone.—There are no easily recognized horizons in the Fort Worth limestone, although the top of the formation, the contact of the Fort Worth with the overlying Denton clay, may be used as a key bed.

Denton clay.—The thinly laminated "ripple-marked" sandstone occurring near the middle of the Denton clay may be used as a key bed. It is easily located, as it frequently forms a distinct bench or terrace, due to the fact that it is harder than the remainder of the formation.

Denton-Weno contact.—The contact of the Denton and Weno is marked by a shell conglomerate composed of countless specimens of *Gryphea washitaensis* and *Ostrea carinata.* This horizon is easily recognized and well suited for structural work.

"Quarry limestone."—This bed which marks the top of the Weno may be used as a key horizon, although care must be taken to prevent confusing it with similar beds in the Pawpaw.

Main Street limestone.—Occurring near the top of the Comanchean is a yellowish-brown, semi-crystalline limestone which is practically the only exception to a clay-sand series of several hundred feet. The Main Street is an excellent marker and well adapted for use as a key horizon.

The intervals between these various horizons having been determined, elevations may of course be taken on any of them and then reduced to a common plane or "Datum."

In that portion of the county covered by the outcrop of the Trinity sand, it has been impossible to do any structural work, as thus far no beds which can be traced or recognized at other localities have been found. The variable character of the Trinity sand and also the cross-bedding and the rapid change in lithologic character tend to make structural work very uncertain.

PALEONTOLOGY

The importance of paleontology in stratigraphic work needs no emphasis. It was thought advisable therefore to include in this report illustrations of a few of the fossils which mark important horizons in the Comanchean of Cooke County. A number of the Comanchean formations of Cooke County are separated chiefly on the basis of their fossil content and a great many of the formations are easily and accurately identified by the fossils they contain. Some of the outstanding facts which the authors have found helpful in field work will be noted with the hope that others working in Cooke County or similar areas will also find them helpful. No attempt is made to list all of the fossils of any of the formations, but merely the index fossils or those characteristic and valuable from a stratigraphic standpoint.

Trinity sand.—The Trinity sand does not, as a rule, contain many fossils, except fossil wood, which is found in abundance in certain localities. However, near the top of the Trinity, in what has been called the Walnut clay formation, fossils are quite abundant at certain horizons. Fossils commonly found at this level include *Exogyra texana* Roemer, *Holectypus planatus* Roemer, *Gryphea marcoui*, and numerous small bivalves.

Goodland limestone.—The lower bed of the Goodland limestone usually carries an abundance of fossils, including *Enallaster texanus* Roemer, *Exogyra texana* Roemer, *Cyprimeria texana* Roemer, and *Gryphea marcoui* Hill and Vaughan. The upper part of the Goodland is characterized by the peculiar marked ammonite *Schloenbachia acutocarinata* Shumard. This ammonite is limited in vertical distribution to the upper part of the Goodland limestone, a few individuals ranging into the lower part of the Kiamichi clay.

Kiamichi clay.—The top of the Kiamichi is marked by a hard shell conglomerate from one to two feet thick composed almost entirely of *Gryphea navia* Hall. This species also occurs rather abundantly in the clay underlying the shell conglomerate. The ammonite *Schloenbachia belknapi* Marcou, which resembles *Schloenbachia acutocarinata*, occurs in the upper part of the Kiamichi, a few forms ranging into the lower part of the Duck Creek.

Duck Creek formation.—The lower part of the Duck Creek contains an abundance of well preserved fossils, including *Inoceramus comancheanus* Cragin, *Hamites comanchensis* Adkins and Winton, *Schloenbachia trinodoso* Böse, and a very large ammonite, *Desmoceras brazoense* Shumard. This "large ammonite" horizon occurs about 25 to 35 feet above the base of the Duck Creek and is limited to a vertical zone of about 8 feet. An abundant horizon of *Hemiaster whitei* Clark occurs just above the "large ammonite" horizon in the lower part of the Duck Creek. The upper part of the Duck Creek, which is made up of marly clay, contains very few fossils as compared to the lower part.

Fort Worth limestone.—The Fort Worth limestone carries a wealth of fossils. Two very important echinoids occur in this section: *Hemiaster elegans* Shumard and *Holaster simplex* Shumard. Other fossils characteristic of the Fort Worth include *Schloenbachia leonensis* Conrad, *Exogyra americana* Marcou which occurs at the top of the Fort Worth. An abundant horizon of *Gryphea washitaensis* Hill usually occurs at the top of the Fort Worth. Fossil "fucoids" are abundant throughout the Fort Worth limestone.

Denton clay.—The top of the Denton clay or the Denton-Weno contact is marked by a very fossiliferous horizon composed chiefly of *Gryphea washitaensis* Hill, with an occasional *Ostrea carinata* Lamarck, and frequently plates and spines of a very ornamented echinoid, probably *Leiocidaris hemigranosus* Shumard. This horizon is very frequently consolidated into a hard brown shell conglomerate.

Weno clay.—The Weno clay contains a number of highly ferruginous sandy clays in its upper part which contain an abundance of fossils. Stephenson lists the following fossils from these ferruginous beds: *Nucula* sp., *Ostrea quadruplicata* Shumard, *Protocardia texana* Conrad, *Cyprimera* sp., *Corbula* (three species), *Cymbopora* sp., *Turritella* sp., *Anchura mudgeana* White, *Engonoceras serpentinum* Cragin. Some of these beds were noted which were composed almost entirely of *Turritella* sp. This enables one to distinguish these beds from similar beds in the Pawpaw, which resembles these beds but does not contain *Turritella* sp. The top of the Weno is marked by the "Quarry limestone," which usually carries an abundance of *Ostrea quadruplicata* Shumard and frequently *Ostrea subovata* Shumard.

Pawpaw sand.—The Pawpaw sandy member contains a number of ferruginous layers and concretions very similar to those found in the Weno. Stephenson lists the following fossils: *Nucula* sp., *Protocardia texana* Conrad, *Cymbopora serpentinum* Cragin. These fossils are practically identical with those listed for the Weno, except the Turritellas are absent.

Main Street limestone.—The Main Street is characterized by two easily recognized fossils. *Exogyra arietina* Roemer is found particularly in the upper part of the Main Street and *Kingena wacoensis* Roemer in the lower part. The last named fossil is the only brachiopod of common occurrence in the Comanchean of this region.

Grayson marl.—*Exogyra arietina* extends into the lower part of the Grayson marl. The fossil most characteristic of the Grayson is *Gryphea mucronata* Gabb, which occurs rather abundantly near the middle of the formation. Other fossils common in the Grayson are *Turrilites brazoensis* Roemer, *Pecten*, *Trigonia*, and *Hoplites*.

Woodbine sand.—No fossils were obtained from the Woodbine in Cooke County, although leaves have been obtained from the lower member (Hill's Dexter sands) of the Woodbine near Denison, Grayson County, Texas.

MINERAL RESOURCES

ASPHALT

The asphalt resources of Cooke County have received very little attention. Numerous occurrences of asphalt as well as "oil seeps" have been reported, but no detailed investigations have been made with special reference to the asphalt deposits. The known asphalt deposits are limited to the western and northwestern portions of the county. The material is a sand asphalt found at or near the top of the Trinity sand, frequently immediately at the contact of the Trinity and overlying Goodland limestone. The source of the asphalt is presumed to be the underlying Pennsylvanian rocks, which due to faulting have permitted the bituminous material to escape, it having collected or impregnated the sand immediately underneath the Goodland limestone. Just to the north of Cooke County, in Love County, Oklahoma, numerous oil seeps and extensive asphalt deposits occur at this same horizon.

The most noted locality in this general region is near St. Jo, Montague County. This locality, as well as the Muenster area of Cooke County, is fully described in a bulletin of the Texas Mineral Survey.[44] St. Jo is not more than two miles west of the Cooke County line, so the conditions there would also apply to Cooke County.

BUILDING STONE

No building stone of commercial value is found in Cooke County, although an abundance of native stone is used locally. One of the chief stones used locally is the Goodland limestone, but due to the fact that it is not evenly bedded, it is difficult to secure material of a uniform size. Several of the other formations contain beds which are used locally. Some of those commonly used are the indurated shell conglomerate at the top of the Kiamichi and the "Quarry limestone" at the top of the Weno. The "Quarry limestone,"

---

44. . . Univ. of Texas Min. Surv., Bull. 3, Chap. 3, 1902.

as has been previously stated, was so named due to the fact that it was extensively quarried for building stone. It is not strictly a limestone and especially in Cooke County would probably be better classed as a sandstone. It is yellowish-brown in color and ranges from two to four feet in thickness. It finds a rather widespread local use for buildings, curbstones, foundations, chimneys, and other purposes. The county courthouse of Denton County, located directly south of Cooke County, is built of "Quarry limestone."

CEMENT

The necessary ingredients for the manufacture of cement are shale or clay and limestone, and in order to profitably manufacture cement these two constituents should be near one another. There also should be a cheap fuel and convenient transportation facilities. The discovery of natural gas in or near Cooke County would solve the fuel problem. There are several formations which would furnish the material. The Goodland limestone which is overlain by Kiamichi clay would present one possibility; the lower Duck Creek formation and also the Fort Worth limestone would be probable sources of material. With the increasing demand for hard surface highways it is believed that the cement possibilities of Cooke County should be considered.

CLAY

There is an abundance of clay suitable for the manufacture of an excellent grade of brick. Thus far the only extensive plant in Cooke County is located a short distance east of Gainesville where clay is used from the Denton formation.

GLASS SAND

Tests have been made on the Trinity sand in southern Oklahoma and results indicate that in certain localities it is pure enough to be used as a glass sand. No tests were made on outcrops of Trinity sand in Cooke County, but the outward appearance of the sand is very similar to that found in Oklahoma and it is believed that portions of the Trinity sand in Cooke County are suitable for use as a glass sand.

GRAVEL

Along most of the larger creeks rather extensive gravel deposits are found. This gravel has found a use on the highways as road material.

LIME

No lime is produced in Cooke County, but with the prospect of a cheap fuel in the form of natural gas it is worth while to mention the Goodland limestone as a possible source of lime. The upper part of the Goodland is especially pure and analysis made of samples collected in Love County, Oklahoma, just north of Cooke County, show it to be of sufficient purity to be used as a source of lime.

WATER

The authors have no new data on the water resources of Cooke County, but for the sake of completeness the material published by Hill[45] on the "Artesian conditions in Cooke County" will be here summarized. While this data was gathered many years ago, it is believed that most of the conclusions have been borne out by subsequent investigations:

> Cooke County, relative to its artesian conditions, may be divided into three divisions: First, a belt along the Red River Valley in the northern portion of the county, established upon the upper part (Paluxy horizon) of the Antlers sands, in which, in order to procure flowing wells, the drills must penetrate to the lower or Trinity reservoir, commencing at the surface in the outcrop of the Goodland limestone or Paluxy sands; second, the area of the Grand Prairie south of a line drawn east and west through Early and north and south through Hemming, in which numerous shallow wells, varying from 150 feet at the northwest

[45]Hill, R. T., U. S. Geol. Surv., 21st Ann. Rept., pt. 7, pp. 583–595, 1901.

to 500 feet at the southeast, may be obtained from the Paluxy reservoirs; thirds, the Eastern Cross Timber district, along the eastern border of the county. This district lies within the catchment area of the Woodbine reservoir, and flowing wells from this source are hardly probable. To procure artesian wells in this district, one must penetrate to depths of 500 feet or more to reach the Paluxy reservoir, and even then flowing wells are hardly probable. Fortunately they are not necessary, inasmuch as surface wells are everywhere easily obtained in this sandy district.

All of the county, except, perhaps, a small portion northwest of Bulcher is underlain by the Antlers sands, which include at least two well defined reservoirs corresponding to the Paluxy and Trinity systems southward. In the southwest quarter of the county wells are everywhere obtained from the upper or Paluxy reservoir at shallow depths, varying from 150 feet on the west to 350 feet along the north and south course of the Elm Fork of Trinity River south of Gainesville. These wells will probably not flow at altitudes above 600 feet, and hence flowing wells are obtainable from this reservoir only in the valley of Elm Fork of the Trinity and its tributaries in the vicinity of Hemming and Valley View, the limit of flow ceasing at some undetermined point about half way between Gainesville and the southern border of the county.

Mr. R. N. Johnson, well driller, has given the following description of the artesian conditions of the upper portion of the Antlers sands, corresponding to the Paluxy reservoir in Cooke County:

In Indian Territory just north of Marysville is a tract of country about 20 miles square in which the water is from 30 to 150 feet in depth, according to the lay of the country. The water seems to be all from the same reservoir. The wells that I have drilled in this district were only to get a supply of water for ordinary farm use. I have never drilled to the lower water reservoir and never have had a well to flow. There is but little solid rock in this district. The formation is soil, clay, and sand (pack sand) which is almost as hard as rock. The water never rises above where you strike it. This country is different on the prairie. Between Red River and Fish Creek the wells of this district range from 120 to 225 feet, and the formation is soil, clay, and rock (of the Fort Worth and Duck Creek formations), from 30 to 140 feet thick, then black slate, or soapstone some call it (the Kiamichi formation), but it is very hard; more rock (the Goodland limestone), then 40 to 60 feet of (Paluxy) sand, then water, which never rises above its level. Near Fish Creek, on the north side, the water is shallow, and there are some good springs.

North and south, and 2 or 3 miles west of Gainesville, there is a tract of prairie country where the water is from 225 to 300 feet deep and when drilled rises to within 25 or 50 feet of the top of the ground. The formations are soil and yellow clay 20 to 30 feet, then a pebbly stratum of rock (of Pleistocene age above the Cretaceous strata); slate or hard soapstone (Kiamichi formation) comes next, then lime rock, and just underneath the last rock (the Goodland limestone) is the water. I have been told by drillers in that country that there is a second water reservoir not more than 50 feet below the first, but the first reservoir supplies enough water for any ordinary use.

Commencing 2 miles west of Gainesville and going 10 miles west, which is as far west as I have worked, the water is from 150 to 200 feet in depth, but it does not rise above where you strike it. The formation is pretty much the same nearer Gainesville. Ten miles south of Gainesville they get a flowing well at 300 to 350 feet, but I never have worked in that part of the country.

I have put down a number of wells in the east and southeast part of this county in the Eastern Cross Timbers, which is a sand country. The water is from 40 to 100 feet in depth.

The whole county is also underlain by at least two lower reservoirs of the Antlers sands, which at Gainesville are about 200 and 600 feet below the Paluxy reservoir. Wells from the lower of these reservoirs will flow at all points below 700 feet in altitude.

The wells of only one locality in the county, at Gainesville, have penetrated to the lower lying Trinity reservoir, which lies some 500 to 600 feet lower than the Paluxy reservoir. Water from this source rises to an altitude of 700 feet, and flowing wells of this character could no doubt be obtained throughout a narrow belt of country adjacent to the Big Elm Fork south of Gainesville, east of the Gulf, Colorado & Santa Fe Railway, and west of the western border of the Eastern Cross Timbers. It is also probable that flowing wells may be obtained from this lower reservoir along the bottoms of Red River north of Bulcher to the eastern portion of the county.

DEVELOPMENT

There are over a hundred shallow flowing and non-flowing artesian wells in the western and southern portion of the county west of the Eastern Cross Timbers which derive their waters from the upper or Paluxy reservoir of the Antlers sands. At one point only in the county have artesian wells been drilled into the lower-lying Trinity reservoir at the base of the Antlers sands. This was done at Gainesville, and the experiment there demonstrates beyond doubt that throughout the vast region of the Grand Prairie from Gainesville to Fort Worth the lower artesian flows are obtainable in case necessities should demand them. The Paluxy reservoir is so prolific throughout this county, however, that only cities and towns wishing a greater volume or flow for municipal or industrial purposes need seek the Trinity reservoir.

The following list of wells has been selected from a rather complete list given by Hill. However, only representative wells from various sections of the county are here quoted.

Shallow Wells from the Paluxy Reservoir

Owner	Location	Total Depth	Depth to First Water	Other Waters	Rise of Water	Flow	Quality
W. W. Locker	Barlow, ½ mile south of postoffice	115	70	......	......	Yes	Hard and contains alkali
H. Wolf	Muenster, 3 miles west of	166	130	......	Yes	......	Soft and potable
H. Vondenbosch	Muenster, 2 blocks east of postoffice	108	90	......	90	......	Hard
J. Davis	Hood, 4 miles northwest of	137	......	......	36	......	Soft and potable
A. J. Harris	Myra, ½ mile south of	220	120	200	Yes	......	Soft and potable, contains soda
C. Enderby	Reed, 2 miles east of	235	......	......	80	......	Soft and potable
J. J. Tew	Reed	244	146	200	40	......	Soft and potable
Wm. Flusche	Lindsay, 1 mile northwest of	190	110	185	90	......	Soft and potable
	Gainesville, 2 miles west of	216	25	205	Yes	......	Soft and potable
R. P. Head	Valley View, 100 feet southwest of postoffice	270	255	......	Yes	......	Soft and potable
A. Ledford	Valley View, 3 miles east of	311	302	......	......	Yes	Soft and potable, contains soda
C. H. Gaines	Hemming, 2 miles north of	369	260	......	......	Yes	Soft and potable, salty
H. Selz	Hemming	426	414	......	......	Yes	Soft and potable
M. A. Stamper	Era	300	200	240 275 300	......	......	

Wells from the Trinity Reservoir

Gainesville Water Co., Gainesville	850	220	360 800	......	Yes	Soft and potable
Public Well, Gainesville	850	250	450	Yes	?	Soft and potable
Gainesville Ice Co., Gainesville	632	215	350 440 620	?	......	
Gainesville Oil Mill and Gin Co., Gainesville	700	220	340 460 670	30	......	

Analysis of Water from Well of Gainesville Oil Mill and Gin Company, Gainesville, Texas

(Showing amount of solids in grains per gallon)

Sodium Chloride	1.700
Potassium Chloride	Trace
Calcium Carbonate	1.000
Sodium Carbonate	28.830
Ferrous Carbonate	1.730
Magnesium Carbonate	0.430
Sodium Sulphate	2,880
Silica	2,100

Analysis of Water from Well of Gainesville Ice Company, Gainesville, Texas

(Showing amount of solids in grains per gallon)

Sodium Chloride	1.1006
Sodium Carbonate	20,6123
Sodium Sulphate	1.7510
Silica	0.6003

Nearly all the artesian wells reported from Cooke County are within 4 or 5 miles of the Big Elm Fork of Trinity River along an east-west belt in the center of the county from west of Muenster to Gainesville and from Gainesville southward toward Valley View and Hemming.

WELLS OF THE PALUXY SAND

All of the wells of the county except the deep wells at Gainesville and possibly one well just south of Barlow are from the top of the Antlers sands, corresponding practically to the Paluxy reservoir, and all of the wells begin in the strata of the Washita division.

The deepest well obtaining water from this reservoir (426 feet) is at Hemming, at the base of the Denison beds; the shallowest (90 feet) is near Muenster, near the base of the Kiamichi clays. At Gainesville the Paluxy reservoir lies about 350 feet below the top of the Fort Worth limestone.

The following reports will show the general character of the wells.

Mr. A. Ledford, who owns a flowing well 311 feet in depth 3 miles east of Valley View, gives the following record of strata passed through.

Section of Well of A. Ledford, 3 Miles West of Valley View, Cooke County, Texas

	Thickness	Depth
Clay (Duck Creek and Fort Worth)	22	22
Blue lime rock (Duck Creek and Fort Worth)	178	200
Slate (Kiamichi)	35	235
White lime rock (Goodland)	35	270
Gray sand rock (Upper Paluxy reservoir)	32	302
Water sand (Antlers)	9	311

R. P. Head, who owns a well 270 feet in depth, located 100 feet southwest of the postoffice at Valley View, says his well passed through principally soapstone and clay and a little shale just before striking water, which was found in white sand.

J. J. Trew, of Reed, gives the following record of strata passed through in his well, which is 244 feet in depth.

Section of Well of J. J. Trew, at Reed, Cooke County, Texas

	Thickness	Depth
Yellow clay (Duck Creek and Kiamichi)	32	32
Blue shale (Duck Creek and Kiamichi)	58	90
Solid lime rock (Goodland)	30	120
Layers of rock from 6" to 12" thick and layers of blue shale the same thickness	26	146
Coarse white sand and water (Antlers sand, Paluxy reservoir)	2	148
Tough mucky clay shale and sand (Antlers sand, Paluxy reservoir)	96	244

Mr. M. A. Stamper, who owns a well 500 feet in depth in the town of Era, Cooke County, gives the following information:

Until recently our water came from surface wells about 20 feet deep, nearly all going dry during summer and fall unless very seasonable. Occasionally near the head of some of the shallows or ravines we found fine water 12 to 18 feet that was almost inexhaustible. For the last few years many wells have been drilled and an abundance of water secured by lifting it to the surface by means of windmills.

After passing through the soil we strike a kind of joint clay and then a blue kind of rock or slaty substance that increases in hardness until it is a solid blue rock. Then we strike what we call a gray shale; then a kind of mixture of various qualities; then a black shale (Kiamichi); then solid rock (Goodland limestone) about 40 to 50 feet; then black sand 5 to 20 feet, and then white sand, pack, or quicksand (Paluxy), with water at 200, 240, 275, and 300 feet in depth.

WELLS FROM THE TRINITY RESERVOIR

Only in the city of Gainesville have wells been drilled to the more copious and stronger waters of the Trinity reservoirs.

Five or six deep wells are reported from this city, one of which, as reported by the mayor, furnished 350,000 gallons of soft potable water a day. In drilling these wells (even although as usual, no exact log of the strata was kept) this enterprising city has demonstrated the existence of the lower artesian reservoirs beneath all that portions of the Grand Prairie region north of Fort Worth, some 90 miles distant, and an area of over 1,000 square miles.

As shown in Figure 75, it will be seen that the deepest of these wells penetrated 630 feet below the Paluxy reservoir into the Antlers sands, and that no less than four distinct water reservoirs were opened, only the lowest of which had sufficient pressure to force the water to the surface.

These reservoirs were found at approximately the following depths below the Paluxy reservoir: 140 feet, 220 feet, 420 to 432 feet, and 630 feet.

Of these wells, only two, that of the public well and the Gainesville Water Company, are complete in that they penetrate the deepest and best water reservoir at 850 feet from the surface.

J. F. Meyers & Son, well drillers, who drilled the well for the Gainesville Water Company could supply the writer with no other information than to state that "the first 240 feet was 'soapstone' and shelly rocks of a limy nature (the Fort Worth, Duck Creek, Kiamichi, and Goodland formations), the balance was principally sand."

In the foregoing discussion Hill uses the terms *Paluxy* and *Antlers* sands which have been abandoned in recent years and the entire division referred to as the Trinity sand. If the reader will bear this in mind and insert Trinity for Antlers sands and think of the Paluxy horizon or reservoir as the upper portion of the Trinity and the Trinity reservoir as used by Hill as the lower Trinity sand, no confusion will result and the terminology used by Hill can be fitted into this report.

PETROLEUM DEVELOPMENTS

BY

E. M. HAWTOF

INTRODUCTION

Oil in Cooke County in commercial quantities was first obtained in the Big Indian, No. 1 Davis, in November, 1924. Since that time this field has been developed and oil has been produced in three other localities. In this paper a brief description will be given of each of the producing areas. The fields described include Bulcher Field, Dangelmayr Pool, and the Muenster and Callisburg areas. A brief description of the subsurface structural conditions of the oil-producing areas is also included.

BULCHER FIELD

This field is located twelve miles northwest of Muenster and nine miles north of Saint Jo, in the northwestern portion of the county. Saint Jo is the closest shipping point.

The first well in this area was completed in June, 1926, by the John W. Hooser Oil Company. This company owns most of the productive acreage, having about thirty of the possibly fifty producing wells. The wells made an initial production of from fifty to one hundred barrels on the pump, then settled down to an average of about twenty barrels. Most of the wells are drilled with a light rotary machine, the formations consisting largely of sands, shales, and thin-bedded limestones. The wells are usually completed in from ten to fifteen days. Generally 6⅝-inch casing is used and is set in the hard shale just a few feet above the pay horizon.

Pay Horizon: The oil-producing horizon is within the Lower Canyon, or Strawn series of the Pennsylvanian. In this area the producing horizon, includes very lenticular sands, shales, and sandy shales. The pay horizon varies in different parts of the field. In the Roxana Hyman No. 1, the southernmost well in the field, this horizon is composed of thin lenses of sand, and sandy shales. North of this well, the sands become much thicker, being possibly from 15 to 25 feet, with a shale break and several feet more of pay sand. A considerable amount of fossil wood and carbonaceous material was noted in cores from the pay horizon taken from various wells.

When the pay is reached very little gas is noted, and none of the wells come in flowing. The oil is fairly good grade, having an asphalt base, and testing approximately 35.5° Baumé. Some idea as to production may be obtained by consulting the table which follows:

Humble Oil Company Pipe Line Report for First Fifteen Days of January, 1927

Company	Lease	Total Run for 15 Days	Daily Average	No. of Wells
Amer. Ref. Co.	J. A. Dennis	1444	76	5
Hooser Oil Co.	J. A. Dennis "A" Lease	7226	488	16
Hooser Oil Co.	J. A. Dennis "B" Lease	118	12	1
Hooser Oil Co.	Hyman Lease	636	42	5
C. C. Lanier	Hyman Lease	1693	113	9
Sun Oil Co.	Hyman Lease	3276	218	9
		14393	949	45

About one barrel per hour of water was encountered in some wells just below the last lime and above the shale in which casing is set. Salt water was encountered at 1136 feet in the Hooser, J. A. Dennis No. 12, this being below the producing horizon.

Structure: The Bulcher structure appears as a nose on the north end of an Ellenburger high which appears to extend almost due southeast of Bulcher. Additional notes on the structural features of the Ellenburger are given in another part of the report. The Trinity formation which is composed of thick beds of sands, and variegated sandy

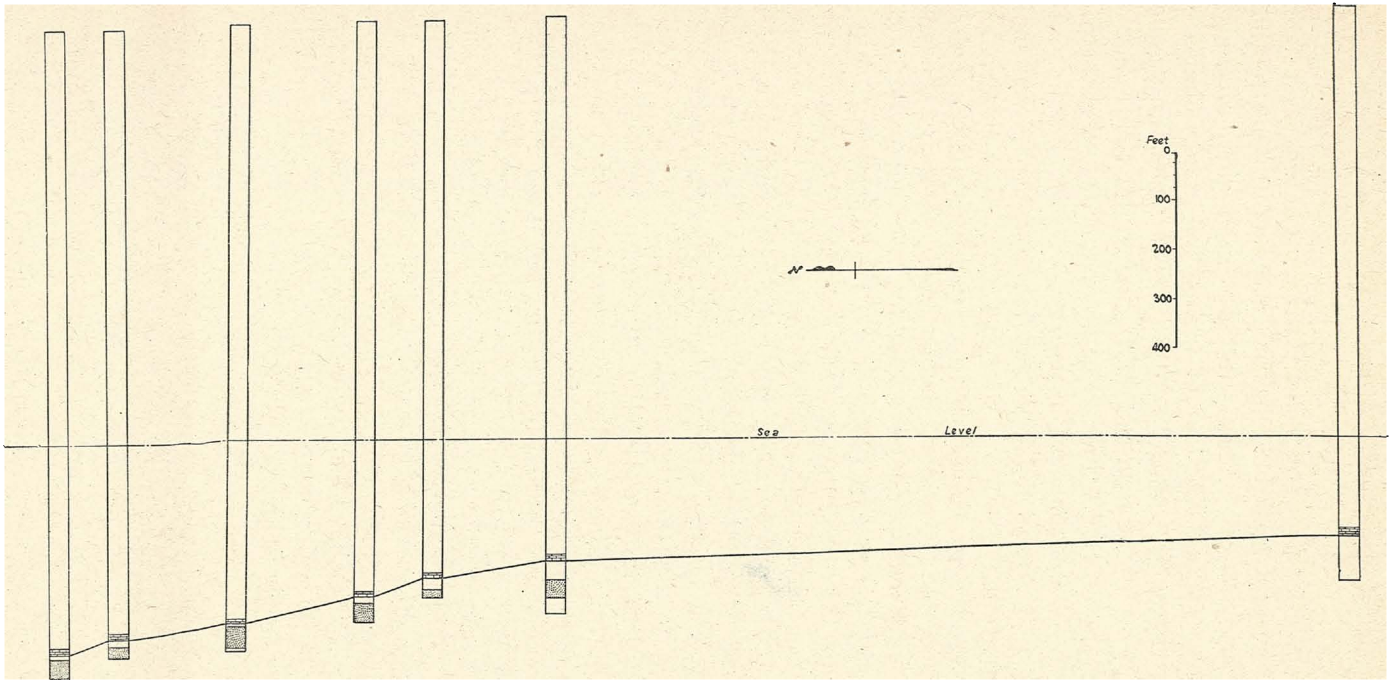


Fig. 4. Cross section of Bulcher Oil Field. The wells from left to right are: Kewanee Oil and Gas Company wells on the J. A. Dennis Farm, 16A, 11A, and 5A; Sun Oil Company wells No. 3 and No. 1 Hyman; Roxana Petroleum Corporation No. 1 Hyman; H. Chapman et al. No. 1 Montgomery.

shales outcrops over this general area. The surface formations show only a slight reflection of the subsurface folding.

Geologic Section: The upper part of the section consists of approximately 420 feet of sands and sandy shales of lower Comanchean age (Trinity). These sands and shales are followed by a series of hard shales and limestones of Pennsylvanian age carrying *Fusulina*, and including the pay horizons. Next above the producing horizon is a shale bed having a thickness of 25 feet or less, and above this shale is a limestone.

The producing sands are very lenticular and change to shale laterally. Owing to the lenticular nature of the sand the highest well on the structure may be the smallest producer, the Roxana Hyman No. 1 being a good illustration. Lower on the structure the wells are better producers, due to the sand thickening. The variation in the sands is seen in the cross section taken from north to south across the structure from the Chapman No. 1, Montgomery the highest well on the structure to the Hooser-Dennis 16-A, which is located on the north flank of the nose. A subsurface map and cross section of the Bulcher field are included in the report. The cross-section extends from a well high on the structure, the H. C. Chapman et al. No. 1 Montgomery, northward to the Kewanee Oil and Gas Company, J. A. Dennis 16A. The structurally low wells on the north flank as indicated in the sketch are the best producers. They have a thick pay sand while in the structurally highest wells the sand at this horizon is wanting. The map, figure 5, was contoured on the top of the last limestone just above the pay horizon. This limestone seems to run quite uniformly throughout the field. The map is based on wells drilled to August, 1927.

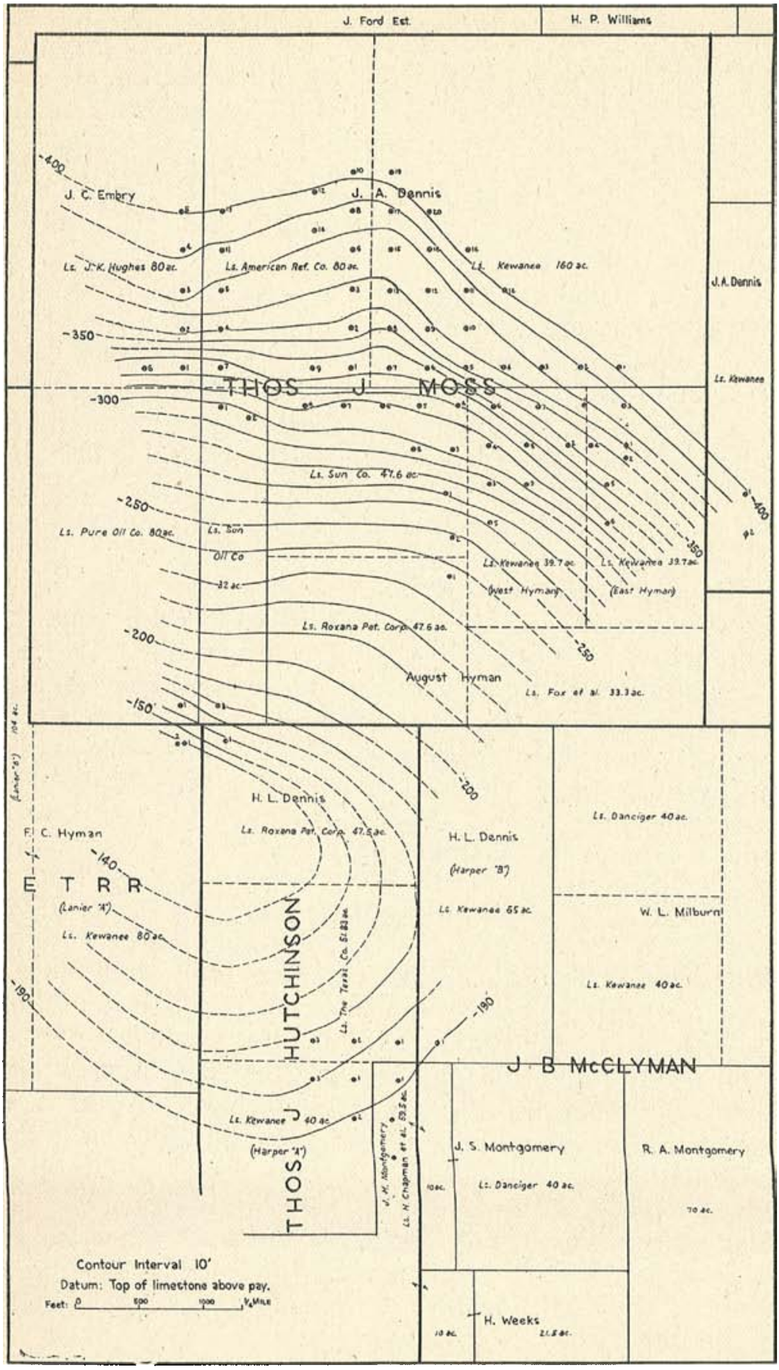


Fig. 5. Structure Map of the Bulcher Oil Field.

CALLISBURG AREA

This area is located ten miles due northeast of Gainesville. Woodbine, on the Missouri, Kansas & Texas Railway, six miles south of the Callisburg well, is the nearest shipping point.

The Big Indian Oil Company, Davis No. 1, two miles east of Callisburg was completed in November, 1924. Production was encountered from a depth of 3510 to 3519 feet. This well was a small producer and was swabbing ten barrels per day at the time this report was written. Two other wells have been drilled through the producing horizon to a depth of approximately 4000 feet without encouraging shows. Very little gas was encountered in any of these wells.

The producing horizon is in the Pennsylvanian some 2300 feet below the Comanchean-Pennsylvanian contact. The great thickness of both the Pennsylvanian and the Comanchean seem to indicate a regional low. The position of the producing horizon in the Pennsylvanian section is not known since no fossils were obtained. The producing sands appear to be quite lenticular in character and contain numerous lenses of shale. The sand itself is not highly porous and is more or less shaly in character.

DANGELMAYR FIELD

The Danglemayr field is located 1½ miles north of Muenster, just north and across the road from the Muenster Deep Test, drilled by the Muenster Oil and Gas Company. Dangelmayr No. 1, drilled by Lynch, Stahl and Burress, in September, 1926, was the first well in the pool. At the time this information was gathered, February, 1927, there were only four wells in the field. The location of the wells is given on map, figure No. 1. These wells known as the Dangelmayr Nos. 1, 2, 3, and 4, yield a total production of 25 barrels per day, practically all this coming from well No. 1. Wells No. 3 and No. 4 are pumping a very little oil, while Dangelmayr No. 2 is a dry hole.

The pay horizon of the first well is approximately 9½ feet in thickness, being composed of a soft, fine-grained, brownish sand. In wells No. 3 and No. 4 the pay horizon is composed of a bluish sandy shale, in which are lenses of brownish medium to fine-grained sand approximately one inch in thickness. From a study of these four wells it is found that the sands are very lenticular, being from one inch to slightly over nine feet in thickness. The producing horizon is Pennsylvanian in age, possibly Strawn series.

Following is a log of the Dangelmayr No. 1 of this pool:

LYNCH, STAHL AND BURRESS WELL

George Ivy Survey, Block 17, center of block. Elevation 1089 feet. Well No. 1, brought in September, 1926.

	Depth in Feet		
	From	To	Thickness
Yellow clay and lime	0	41	41
Lime	41	81	40
Shale	81	89	8
Lime	89	107	18
Sandy shale	107	129	22
Lime	129	131	2
Sandy shale	131	207	76
Hard sand	207	247	40
Sand	247	266	19
Blue gumbo	266	275	9
Sand	275	383	108
Red shale	383	387	4
Soft sand	387	393	6
Lime	393	411	18
Sand	411	451	40
Blue sandy shale	451	465	25
Hard lime	465	485	20
Gray shale	485	516	31
Hard lime	516	518	2
Blue shale	518	524	6
Sandy lime	524	539	15
Sandy shale	539	559	20
Sandy lime	559	563	4
Blue shale	563	578	15
Pink shale	578	600	22
Shale	600	640	40
Sand	640	646	6
Sandy lime	646	654	8

	Depth in Feet		
	From	To	Thickness
Lime	654	662	8
Blue shale	662	696	34
Shale, thin lime shells	696	708	12
Sand, ran core at 712 feet	708	727	19
Shale, thin lime shells	727	738	11
Broken lime	738	759	21
Blue sandy shale	759	797	38
Oil sand, cored oil sand	797	806½	9½

MUENSTER FIELD

The Luke No. 1, drilled by the Oil Operators' Trust, located in the Muenster Townsite, was completed in January, 1927, as the first producer in the field, with an initial production estimated at fifty barrels. The production was obtained from the Pennsylvanian at a depth of 1277–1282 feet. The base of the Comanchean appears to be at 420 feet (±), and the producing horizon which is five feet thick, some 850 feet below the Comanchean-Pennsylvanian contact. The uppermost part of the producing sand is somewhat compact, but seems to be coarser and more porous towards the bottom. Oil from this horizon is reported to have specific gravity of from 34° to 36° Baumé. Several months later a deeper sand was discovered in the field, at a depth slightly over 1600 feet. These deeper wells when drilled in, swab from 100 to 200 barrels a day, but settle to pumpers, making from 17 to 100 barrels a day. The oil produced from this second horizon is reported to test from 30 to 32 degrees gravity Baumé.

The general trend of the field is from northwest to southeast, following the west flank of the Ellenburger high. The field at present covers approximately 225 acres, having a length of about one mile, although not more than one-half mile wide. The Wm. Waltersheid No. 1, drilled by E. S. Carey, indicates a possible north extension to the field in the 1300-foot sand.

Following are two well records, one of a producer in the shallow sand and the other of a well producing from the deeper horizon:

BEN LUKE NO. 1, OIL OPERATORS' TRUST

Located in southwest corner of Block 88, being 150 feet from the south line and 150 feet from the west line. Elevation 959 feet. Initial production about 75 barrels in Muenster Field.

	Depth in Feet		
	From	To	Thickness
Clay	0	54	54
Clay and sand	54	114	60
Sand to hard sand	114	159	45
Light sand	159	173	14
Hard sand rock	173	175	2
Loose sand and gyp	175	210	35
Hard sand rock	210	213	3
Pack sand	213	275	62
Hard sandy lime	275	278	3
Sandy shale	278	350	72
Sand and shells	350	395	45
Hard sandy lime	395	400	5
Pack sand	400	420	20
Broken sandy lime	420	445	25
Pack sand and broken lime	445	510	65
Sandy shale	510	545	35
Broken lime	545	560	15
Sandy shale	560	600	40
Broken sandy lime	600	625	25
Hard lime	625	643	18
Broken lime	643	652	9
Shale	652	654	2
Sandy shale	654	668	14
Sticky shale	668	676	8
Hard sand	676	678	2
Sticky shale	678	695	17
Broken sand	695	698	3
Sticky shale	698	703	5
Sandy shale	703	765	62
Broken sand	765	781	16
Sandy shale	781	830	49
Sand and shale	830	862	32
Sandy shale	862	900	38
Sand	900	910	10
Sandy shale	910	934	24
Sand and shale	934	954	20
Hard lime	954	968	14
Broken lime	968	978	10
Sticky shale	978	990	12

	Depth in Feet		
	From	To	Thickness
Sandy shale	990	994	4
Sticky shale	994	1020	26
Broken lime	1020	1030	10
Sandy shale	1030	1060	30
Broken lime	1060	1088	28
Sticky shale	1088	1185	97
Broken lime	1185	1216	31
Gumbo	1216	1233	17
Sticky shale	1233	1238	5
Gyp and gumbo	1238	1260	22
Hard lime	1260	1268	8
Oil sand	1268	1279	11
Cored broken sand	1279	1280	1
Oil sand	1280	1281	1
Sandy shale oil sand	1281	1283	2

WELLESLEY NO. 1, GRAY AND ADAMS, INC.

Located in the southwest corner of Block 59, Townsite of Muenster, Texas. Elevation, 959.35 feet; 6⅝-inch casing set at 1586 feet.

	Depth in Feet		
	From	To	Thickness
Surface soil	0	15	15
Pack sand	15	30	15
Sandy shale	30	60	30
Broken sand	60	175	115
Sand and boulders	175	185	10
Broken sand	185	200	15
Broken sand lime shell	200	356	156
Hard sand	356	381	25
Water sand	381	396	15
Soft sand	396	402	6
Sand	402	476	74
Pack sand	476	500	24
Red bed sticky shale	500	515	15
Broken sandy lime	515	574	59
Red bed sticky shale	574	622	48
Broken sand	622	636	14
Hard lime	636	642	6
Lime rock	642	662	20
Sticky shale	662	670	8
Sand and red bed	670	740	70
Sand red bed	740	746	6

	Depth in Feet		
	From	To	Thickness
Sandy shale-asphalt	746	833	87
Sticky shale	833	903	70
Sand and lime	903	915	12
Sandy lime	915	930	15
Lime rock	930	969	39
Sticky shale	969	976	7
Lime shell	976	978	2
Sticky shale	978	1080	102
Pack sand	1080	1096	16
Sticky shale	1096	1204	108
Sand	1204	1216	12
Sticky shale	1216	1240	24
Sand-shale-boulder	1240	1255	15
Gumbo	1255	1260	5
Broken sandy lime	1260	1289	29
Hard lime and shale	1289	1293	4
Sand showing oil	1293	1296	3
Limey shale	1296	1301	5
Sand-oil	1301	1302	1
Oil sand	1302	1317	15
Hard lime	1317	1320	3
Broken shale	1320	1331	11
Broken shale-lime	1331	1377	46
Hard shale and lime	1377	1403	26
Sandy lime	1403	1430	27
Broken lime	1430	1444	14
Lime rock	1444	1456	12
Sticky lime	1456	1476	20
Sticky shale	1476	1480	4
Hard sandy lime	1480	1486	6
Broken lime	1486	1520	34
Sticky lime	1520	1525	5
Sandy lime	1525	1537	12
Sticky shale	1537	1574	37
Gumbo	1574	1586	8
Lime rock	1586	1587	1
Oil sand	1587	1608	21

STRUCTIONAL FEATURES INDICATED BY THE ELLENBURGER FORMATION

A number of wells in Cooke County, after passing through the Pennsylvanian enter the Ellenburger (Cambrian-Ordovician), and at least one well has penetrated schist underneath the Ellenburger. These wells are of importance for their bearing on regional structural features in the county.

From these records there appears to exist a large regional high extending in a general northwest-southeast direction, beginning in the northwest part of the county; the southern portion has somewhat of an offset to the west then resumes its general direction to the southeast passing into northern Denton County. Wells drilled east of this regional high, in the northeast and eastern part of the county, show evidence of an extensive regional low.

The sub-sea position of the Ellenburger has been indicated in 100-foot contours on map of figure 6. The axis of this high is indicated by the following wells: Mount No. 1, drilled by McElreath and Suggett, located on Section 9, Southern Pacific Railway Company, four miles south of Bulcher and nine miles north of Muenster where the Ellenburger was encountered at a depth of —767 feet, and by a well drilled by Tippett and Darnall on the Ball farm three miles north of Myra where the Ellenburger was found at a depth of —690 feet. The axis of the offset portion of the regional high may be determined by the following wells: Hire and Seagraves No. 1, drilled by the Petroleum Investment Company, located approximately two miles south of Hood, in which well the top of the Ellenburger was not definitely known due to lack of samples, but from the one sample obtained the Ellenburger seems to have possibly been penetrated even above —641 feet; then the J. H. Hughes No. 1, located in Denton County, just south of the Denton-Cooke County line, on the John Morton Survey. This well penetrated a brecciated rock being composed in part of reworked Ellenburger, but the top of Ellenburger is placed at a depth of —650 feet. The Ellenburger is found considerably lower on both sides of these axes, indicating the presence of a large subsurface high.

In this connection the reader's attention is directed to the Wade No. 1, drilled by Jones and Eubanks, located about one mile south of the Denton-Cooke County line, on the

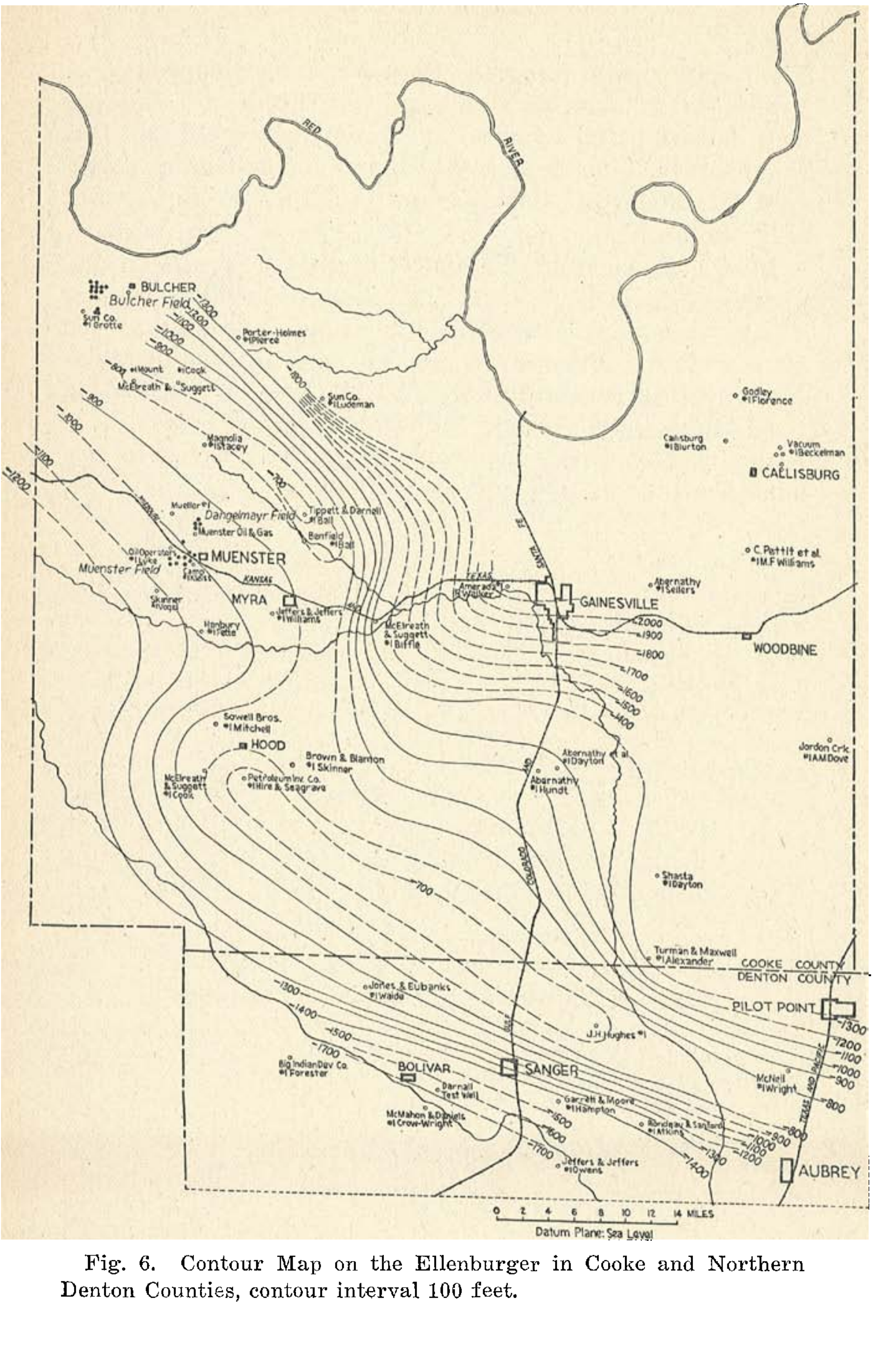


Fig. 6. Contour Map on the Ellenburger in Cooke and Northern Denton Counties, contour interval 100 feet.

Thomas Carpenter Survey in Denton County, this well penetrated granitic gneiss at a depth of 1870 feet. Another well of considerable interest is the Muenster Oil and Gas Company Well No. 1, located two and one-half miles northwest of Muenster, Cooke County, Texas, which stopped drilling in schist.

Information obtained from wells drilled in eastern and northeastern Cooke County indicate the possible presence of a large regional low. The formations appear to thicken considerably in the wells in this area, as indicated by Davis No. 1, drilled by the Big Indian Oil Company, located on the Fannin County school land, north one-half Lot No. 9. In this well the following formation groups have been recognized:

	Depth in Feet		
	From	To	Thickness
Woodbine	0	185	185
Washita series	185	585	400
Goodland limestone	585	605	20
Trinity series	605	1400	795
Pennsylvanian	1400	3521	2121

The Kitchens No. 1, drilled by the Vacuum Oil Company, located approximately one mile east of Callisburg, on Block No. 1248, Lot No. 9, appeared to have stopped drilling in Pennsylvanian formations at a depth of 4310 feet, having drilled about 2900 feet into the Pennsylvania.

WELL DATA

JOHN ALEXANDER NO. 1, TURMAN AND MAXWELL

Located in the central part of the John Alexander 80-acre farm, John Gregg Survey, seven miles west and four miles north of Pilot Point. Elevation, 663 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Surface sand	0	22	22
Sand	22	27	5

	Depth in Feet		
	From	To	Thickness
Shale	27	49	22
Hard sand	49	54	5
Blue shale	54	82	28
Shale and lime	82	88	6
Sand, shale, and lime shells	88	140	52
Soft chalky lime and white slate	140	186	46
Shale and lime	186	203	17
Shale	203	211	8
Hard shale and lime	211	294	83
Lime	294	304	10
Lime and chalk	304	350	46
Hard shale and lime	350	400	50
Sandy lime	400	405	5
Sandy lime and shale	405	426	21
Sticky shale	426	434	8
Sandy shale and sand	434	554	120
Hard sand	554	560	6
Hard shale and sand	560	612	52
Sandy lime rock	612	615	3
Hard shale and sand	615	663	48
Hard sandy shale	663	669	6
Brown sandy lime	669	677	8
Sand water	677	697	20
Sandy lime	697	702	5
Hard shale and sand	702	723	21
Sandy lime and pyrites	723	728	5
Hard sand, dry, white	728	736	8
Sandy shale	736	761	25
Sticky shale	761	781	20
Brown lime	781	788	7
Brown lime and shale	788	791	3
Hard sand	791	803	12
Sandy shale	803	821	18
Water sand	821	841	20
Sand and lime shells	841	849	8
Red sticky shale	849	859	10
Shale and sand, shells	859	878	19
Shale and sand	878	899	21
Sandy lime	899	903	4
White sand and lime shells	903	919	16
Hard shale and sand	919	983	64
Hard shale and sand	983	997	14
Water sand	997	1032	35
Sandy shale and water sand	1032	1052	20

	Depth in Feet		
	From	To	Thickness
Sticky shale	1052	1060	8
Water sand and gravel	1060	1065	5
Sandy shale	1065	1082	17
Red sticky shale	1082	1089	7
Hard sandy shale	1089	1092	3
Lime shell	1092	1093	1
Red sticky shale	1093	1116	23
Dry white sand	1116	1120	4
Sandy shale	1120	1142	22
Hard shale and lime shells	1142	1146	4
Sandy shale	1146	1190	44
Lime shell	1190	1212	22
Pink shale	1212	1219	7
Shale and brown lime	1219	1238	19
Hard sharp sand, dry	1238	1244	6
Hard sand	1244	1245	1
Sandy shale	1245	1259	14
Hard dry sand, white	1259	1261	2
Sandy shale	1261	1277	16
Yellow gumbo	1277	1282	5
Sandy shale	1282	1289	7
Lime	1289	1290	1
Sand and shale, alternating	1290	1309	19
Lime	1309	1311	2
Shale	1311	1313	2
Lime	1313	1314	1
Sand, water, salty	1314	1329	15
Sticky shale	1329	1342	13
Hard sand	1342	1345	3
Sticky shale and boulders	1345	1365	20
Hard crystallized sand	1365	1373	8
Sticky shale	1373	1377	4
Lime shell	1377	1378	1
Sticky shale	1378	1394	16
Hard shale and sand	1394	1417	23
Hard sand (water)	1417	1431	14
Brown lime	1431	1434	3
Sand (water)	1434	1444	10
Sticky shale, blue	1444	1455	11
Sand	1455	1470	15
Sticky shale, blue	1470	1496	26
Hard sand	1496	1497	1
Lime (very hard)	1497	1498	1
Lime	1498	1501	3

	Depth in Feet		
	From	To	Thickness
Gumbo, black	1501	1505	4
Sandy shale	1505	1509	4
Shale, blue	1509	1538	29
Hard shale and sand	1538	1542	4
Hard sand and shale	1542	1547	5
Hard lime	1547	1552	5
Brown lime and sand	1552	1556	4
Brown lime and hard sand	1566	1564	8
Brown lime, black	1564	1578	14
Hard sand, black	1578	1586	8
Brown lime and hard sand	1586	1598	12
Blue shale	1598	1626	28
Shale	1626	1720	94
Hard lime	1720	1724	4
Hard sand and shale	1724	1727	3
Hard sand	1727	1730	3
Sticky shale, blue	1730	1752	22
Gumbo	1752	1760	8
Sandy shale	1760	1779	17
Sticky shale	1779	1802	23
Brown lime	1802	1807	5
Hard lime	1807	1810	3
Sticky shale, blue	1810	1836	26
Brown lime	1836	1842	6
Brown lime sand	1842	1858	16
Brown lime	1858	1895	37
Lime	1895	1896	1
Pink shale	1896	1899	3
Lime	1899	1908	9
Brown lime	1908	1910	2
Shale, brown	1910	1913	3
Sandy lime	1913	1914	1
Hard shale and lime	1914	1920	6
Broken lime	1920	1924	4
Lime	1924	1926	2
Gypsum	1926	1929	3
Sticky shale	1929	1932	3
Lime shell	1932	1933	1
Sticky shale, red	1933	1943	10
Hard shale and lime	1943	1948	5
Lime, gray	1948	1950	2
Sticky shale, red	1950	1970	20
Sticky shale, dark brown	1970	1972	2
Hard lime	1972	1978	6

	Depth in Feet		
	From	To	Thickness
Lime	1978	2008	30
Gray lime	2008	2049	41
Hard lime, gray	2049	2053	4
Lime, gray	2053	2074	21
Hard lime, gray	2074	2080	6
Lime (steel line measurement)	2080	2083′ 3″	3′ 3″

Description of Sample by O. M. Richey and E. H. Sellards

	Depth	
	Ft.	In.
A small piece of a core of brownish-gray dolomitic limestone. In thin section the rock was seen to be finely crystalline. Two or three small areas of coarsely crystalline material noted	2079	
A core of brownish-gray limestone cut by narrow seams of calcite and impregnated with bituminous material. In thin section the rock was found to be, for the most part, fairly coarsely crystalline, although there are some finer grained areas. The bituminous material appeared to be concentrated chiefly in the coarsely crystalline areas, although staining was noted in the finer grained areas. The larger crystals are characteristically rhombohedral in outline. They are light near the edge and dense in the center	2083	3

Both samples are identified as Ellenburger.

BROWN AND BLANTON NO. 1, SKINNER AND SIMMS OIL COMPANY

Located on the Brown Farm, formerly known as the "Old M. W. Hudson Farm"; partly the B. A. Foreman Survey; two miles east and one mile south of Hood. Elevation, 949 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Surface and boulders	0	30	30
Broken sand	30	47	17
Shale	47	48	1
Lime shell	48	70	22
Shale and boulders	70	78	8
Shale	78	106	28
Broken lime	106	109	3

	Depth in Feet		
	From	To	Thickness
Shale	109	118	9
Lime rock	118	124	6
Sand	124	139	15
Broken lime	139	147	8
Lime rock	147	150	3
Shale	150	155	5
Lime shell	155	156	1
Shale	156	160	4
Sand	160	168	8
Lime rock	168	172	4
Sand shale	172	179	7
Dry sand	179	185	6
Shale	185	232	47
Sand	232	270	38
Sand and shale	270	331	61
Hard sand	331	373	42
Sand	373	393	20
Shale	393	405	12
Sandy shale	405	450	45
Sand and shale	450	493	43
Sticky shale	493	505	12
Sand	505	538	33
Sandy shale	538	550	12
Hard sand	550	558	8
Sticky shale	558	580	22
Sand	580	584	4
Sandy shale	584	642	68
Sticky shale	642	672	30
Sandy shale	672	676	4
Lime rock	676	681	5
Sticky shale	681	705	24
Sandy shale	705	715	10
Sandy lime	715	719	4
Hard sand	719	723	4
Broken lime	723	727	4
Shale	727	750	23
Broken lime	750	757	7
Hard shale	757	807	50
Sandy lime	807	810	3
Sand shale	810	826	16
Hard lime	826	833	7
Sandy lime	833	846	13
Sandy lime and lime shells	846	855	9
Shale	855	867	12

	Depth in Feet		
	From	To	Thickness
Shale and boulders	867	900	33
Shale and boulders	900	928	28
Hard lime	928	958	30
Lime	958	966	8
Red shale	966	973	7
Lime	973	984	11
Shale and lime	984	996	12
Shale and lime boulders	996	1002	6
Shale	1002	1006	4
Sand rock	1006	1007	1
Hard sand	1007	1010	3
Hard lime	1010	1013	3
Shale	1013	1020	7
Hard sand	1020	1033	13
Shale and boulders	1033	1050	17
Sandy shale	1050	1113	63
Sand rock	1113	1114	1
Blue clay	1114	1217	103
Broken lime and shale	1217	1227	10
Blue clay and gummy shale	1227	1235	8
Hard lime rock	1235	1238	3
Hard shale	1238	1245	7
Sandy shale	1245	1248	3
Gummy shale	1248	1251	3
Hard lime with little sand	1251	1253	2
Hard lime and pyrite	1253	1256	3
Hard lime and pyrite with sand	1256	1259	3
Shale with strata of lime	1259	1262	3
Hard lime	1262	1265	3
Broken lime and shale	1265	1280	15
Sandy with hard streaks of lime	1280	1282	2
Shale and shell	1282	1284	2
Hard lime	1284	1290	6
Broken lime and sticky shale	1290	1296	6
Broken lime and shale	1296	1316	20
Hard sandy lime and pyrites	1316	1336	20
Broken lime and sticky shale	1336	1344	8
Hard sandy lime	1344	1350	6
Gumbo	1350	1365	15
Hard lime	1365	1367	2
Broken lime and sticky shale	1367	1371	4
Hard lime	1371	1373	2
Shale	1373	1389	16
Broken lime and shale	1389	1393	4

	Depth in Feet From	To	Thickness
Broken lime and sticky shale	1393	1403	10
Broken lime and gummy shale	1403	1418	15
Broken lime and hard pyrites	1418	1426	8
Gummy shale and mucky lime	1426	1451	25
Hard shale and streaks of lime	1451	1479	28
Gumbo	1479	1481	2
Hard broken lime	1481	1485	4
Tough gumbo	1485	1489	4
Hard shale and streaks of lime	1489	1527	38
Hard sandy lime	1527	1532	5
Hard sand	1532	1538	6
Hard shale with streaks of gumbo	1538	1567	29
Hard shale with streaks of lime	1567	1577	10
Hard sandy lime	1577	1579	2
Hard lime rock	1579	1582	3
Hard sandy lime	1582	1584	2
Hard shale with lime	1584	1589	5
Hard sticky shale	1589	1600	11
Broken lime	1600	1602	2
Hard lime	1602	1606	4
Sticky shale with lime	1606	1620	14
Hard lime	1620	1626	6
Gumbo	1626	1630	4
Hard lime	1630	1640	10
Hard lime and pyrites	1640	1642	2
Hard lime	1642	1650	8
Hard shale and streaks of lime	1650	1666	16
Hard shale and sand (cored)	1666	1667	1
Hard sandy lime	1667	1671	4
Hard shale	1671	1677	6
Hard sandy lime with pyrites	1677	1683	6
Sticky shale and lime	1683	1686	3
Hard lime	1686	1691	5
Sticky shale	1691	1698	7
Hard shale with streak of lime	1698	1707	9
Hard lime with pyrites	1707	1710	3
Hard sandy lime with pyrites	1710	1711	1
Hard sandy lime	1711	1713	2
Hard lime	1713	1735	22
Hard slate with streaks of lime (cored)	1735	1740	5
Hard sandy lime	1740	1750	10
Hard lime	1750	1785	35
Cored Ellenburger lime conglomerate	1785	1786	1
Ellenburger lime	1786	1793	7

Sample at 1793 feet determined as Ellenburger by E. M. Hawtof.

J. G. BIFFLE NO. 1, McELREATH AND SUGGETT

Located 660 feet east of the west line, and 1470 feet south of the north line, Robert Shannon Survey; three miles east and one mile south of Myra, Texas. Elevation, 839.5 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Clay	0	15	15
Lime	15	18	3
Sand	18	23	5
Broken lime and shale	23	40	17
Lime	40	103	63
Sand	103	228	125
Lime	228	230	2
Broken sand	230	259	29
Lime	259	263	4
Sand	263	343	80
Red beds	343	582	239
Sand	582	648	66
Shale	648	656	8
Hard sand	656	659	3
Shale	659	720	61
Sand	720	739	19
Sandy lime	739	751	12
Gumbo	751	773	22
Sand	773	791	18
Gumbo	791	860	69
Lime	860	862	2
Shale and shells	862	903	41
Lime	903	905	2
Gumbo	905	935	30
Hard sand	935	952	17
Shale and shells	952	970	18
Sandy lime	970	972	2
Gumbo	972	982	10
Sandy lime	982	986	4
Sand	986	989	3
Sandy lime	989	998	9
Shale	998	1002	4
Lime	1002	1005	3
Gumbo	1005	1012	7
Blue sand	1012	1018	6

	Depth in Feet		
	From	To	Thickness
Sticky shale	1018	1023	5
Sandy lime	1023	1028	5
Gumbo	1028	1056	28
Hard sand	1056	1080	24
Sticky shale	1080	1086	6
Dry sand	1086	1102	16
Sticky shale and sand	1102	1117	15
Hard sand	1117	1143	26
Sand, dry	1143	1148	5
Shale	1148	1154	6
Sandy lime	1154	1156	2
Sandy shale	1156	1184	28
Gumbo	1184	1203	19
Gumbo and lime	1203	1220	17
Shale	1220	1246	26
Sandy lime	1246	1248	2
Sandy shale	1248	1274	26
Sandy lime	1274	1280	6
Sharp sand	1280	1282	2
Sandy lime	1282	1321	39
Sticky shale	1321	1328	7
Sandy shale	1328	1346	18
Gumbo	1346	1370	24
Shale	1370	1389	18
Gumbo	1389	1402	13
Lime	1402	1405	3
Clay	1405	1412	7
Sandy shale	1412	1427	15
Gumbo	1427	1438	11
Sand	1438	1444	6
Sticky shale	1444	1459	15
Broken lime	1459	1476	17
Sand and boulders	1476	1526	50
Gumbo and shells	1526	1554	28
Sandy shale	1554	1559	5
Sticky shale	1559	1580	71
Shale	1580	1596	16
Broken sandy lime	1596	1614	18
Gumbo	1614	1622	8
Hard sand	1622	1630	8
Sticky shale	1630	1659	29
Hard sand, broken	1659	1679	20
Shale and boulders	1679	1681	2
Sandy shale	1681	1685	4

	Depth in Feet		
	From	To	Thickness
Hard sand	1685	1691	6
Shale and shells	1691	1705	14
Hard sand	1705	1709	4
Shale	1709	1711	2
Hard sand	1711	1736	25
Gumbo	1736	1747	11
Sand and lime	1747	1751	4
Shale and shells	1751	1755	4
Lime	1755	1758	3
Gumbo	1758	1770	12
Broken sand	1770	1800	30
Sticky shale	1800	1844	44
Shale	1844	1907	63
Sticky shale	1907	1937	30
Shale	1937	1964	27
Lime	1964	1967	3
Gumbo	1967	1969	2
Lime	1969	1994	25
Gumbo	1994	2000	6
Lime	2000	2025	25
Shale	2025	2027	2
Sandy lime	2027	2028	1
Lime	2028	2030	2
Gumbo and shells	2030	2034	4
Sticky shale	2034	2074	40
Lime	2074	2077	3
Shale	2077	2100	23
Lime	2100	2101	14
Broken lime	2101	2114	13
Hard shale	2114	2121	7
Sandy lime	2121	2146	25
Hard lime	2146	2156	10
Lime	2156	2168	12
Ellenburger lime	2201		

J. M. COOK NO. 1, McELREATH AND SUGGETT

Located 150 feet south and east of the most westernly northwest corner of the Southern Pacific Railroad Survey No. 7, one and one-half miles west and one mile south of Hood. Elevation, 1055 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Lime and lime boulders	0	28	28
Lime	28	36	8

	Depth in Feet		
	From	To	Thickness
Shale	36	51	15
Hard sand	51	58	7
Sand	58	64	6
Shale	64	125	61
Sand	125	330	205
Shale	330	341	11
Sand	341	345	4
Shale	345	480	35
Sand	480	551	71
Shale	551	583	32
Sand	583	590	7
Broken lime and sand	590	605	15
Sandy lime	605	611	6
Gumbo	611	615	4
Shale	615	659	4
Sand	659	662	3
Shale	662	668	6
Gumbo	668	676	8
Sand	676	680	4
Sticky shale	680	702	22
Sandy lime	702	706	4
Gumbo	706	720	14
Sticky shale and sand	720	760	40
Sand	760	772	12
Gumbo	772	786	14
Lime	786	790	4
Sticky shale	790	804	14
Sandy lime	804	805	1
Gumbo	805	820	15
Gypsum	820	823	3
Hard lime	823	828	5
Lime	828	833	5
Lime rock	833	842	9
Sandy lime	842	845	3
Gumbo	845	860	15
Shale	860	877	17
Lime	877	879	2
Sandy shale, dry	879	885	6
Gumbo	885	895	10
Sandy lime	895	897	2
Gumbo	897	905	8
Sand, dry	905	909	4
Gumbo	909	920	11
Sandy shale	920	930	10

	Depth in Feet		
	From	To	Thickness
Lime	930	932	2
Gumbo and boulders	932	939	7
Gumbo—reduced hole, reduced at 949	939	969	30
Sticky shale	969	1017	48
Lime	1017	1019	2
Broken lime—reamed hole	1019	1026	7
Lime	1026	1027	1
Hard lime	1027	1031	4
Gyp	1031	1036	5
Shale, sand, and lime (Took core at 1048–50)	1036	1066	30
Shale	1066	1070	4
Sand, dry	1070	1085	15
Lime—reamed hole 1036–1081	1085	1086	1
Lime	1086	1096	10
Hard sandy lime	1096	1106	10
Dry sand	1106	1108	2
Shale, sand, and lime	1108	1128	20
Sticky shale	1128	1140	12
Lime	1140	1142	2
Shale	1142	1153	11
Sand	1153	1158	5
Shale, shell, and sand	1158	1177	19
Lime	1177	1180	3
Sticky shale	1180	1188	8
Hard lime	1188	1190	2
Lime	1190	1192	2
Shale	1192	1197	5
Sand, dry	1197	1205	8
Shale	1205	1210	5
Broken sand, dry	1210	1217	7
Sticky shale	1217	1230	13
Lime	1230	1232	2
Shale	1232	1235	3
Broken lime	1235	1239	4
Shale	1239	1250	11
Hard lime	1250	1258	8
Lime	1258	1261	3
Broken lime	1261	1265	4
Shale, sand and shell	1265	1295	30
Shale	1295	1307	12
Lime	1307	1310	3
Shale and lime shell	1310	1321	11
Lime (1325)	1321	1325	4
Sand, dry	1325	1332	7

	Depth in Feet From	To	Thickness
Lime	1332	1334	2
Sand, dry	1334	1338	4
Shale	1338	1360	22
Sand water	1360	1374	14
Shale, sand, and shells	1374	1395	21
Sand and shale	1395	1458	63
Sand, dry	1458	1462	4
Gumbo	1462	1470	8
Gumbo and sticky shale	1470	1515	45
Sand, dry	1515	1519	4
Gumbo	1519	1531	12
Sand, dry	1531	1532	1
Sticky shale	1532	1544	12
Sand and lime, dry	1544	1548	4
Dry sand—broken	1548	1557	9
Lime	1557	1566	9
Gumbo	1566	1589	33
Hard dry sand	1589	1598	9
Gumbo	1598	1612	14
Sand, dry	1612	1617	5
Hard sand	1617	1627	10
Sandy lime	1627	1635	8
Shale	1635	1637	2
Sandy lime	1637	1640	3
Lime	1640	1648	8
Sand shale and lime	1648	1674	26
Shale	1674	1676	2
Gumbo	1676	1698	22
Sand, shale, and shells	1698	1710	12
Sand, hard	1710	1716	6
Gumbo	1716	1727	11
Sand and shale	1727	1767	40
Sand and lime shells	1767	1782	15
Gumbo	1782	1806	24
Sand and shale	1806	1816	10
Hard sand	1816	1830	14
Sandy lime	1830	833	3
Gumbo	1833	1847	14
Sand	1847	1859	12
Lime	1859	1890	31
T. D.	1890		

Description of Sample by E. M. Hawtof and E. H. Sellards

	Depth in Feet
A piece of core of brownish-gray exceedingly fragmental limestone which in many parts is composed of various-sized areas of brownish crystalline calcite; also small areas of probably dolomite. The rock contains fractures, these fractures being filled usually by a brownish crystalline calcite, and often by asphalt. It was noted in the thin section that casts of fossils were present but indistinct, frequently having been replaced by crystalline calcite, wholly or in part	1890

Pre-Pennsylvanian, probably Ellenburger.

DAVIS NO. 1 (BIG INDIAN WELL NO. 1)

Located on Fannin County school land, N. ½ Lot No. 9, 1 mile east of Callisburg. Drilling began August 16,1922. Set 5 3/16-inch casing with packer at 3521.

Driller's Log

		Depth in Feet		
		From	To	Thickness
	Yellow clay	0	10	10
	Blue shale	10	20	10
	Red gumbo	20	25	5
	Gray shale	25	30	5
	Red gumbo	30	40	10
	Gray shale	40	50	10
Woodbine	Red gumbo	50	75	25
	Blue shale	75	85	10
	Red gumbo	85	105	20
	Gray shale	105	115	10
	Red gumbo	115	130	15
	Water sand set 20 inches	130	180	50
	Gray shale	180	185	5
	Gray lime	185	192	7
	Blue shale	192	196	4
	Gray lime	196	206	10
	Blue shale	206	243	37
	Gray lime	243	247	4
	Blue shale	247	275	28
	Gray lime, water	275	285	10
	Blue shale	285	330	45
	Gray lime	330	335	5
	Blue shale	335	369	34

		Depth in Feet		
		From	To	Thickness
	Gray lime	369	385	16
	Blue shale	385	390	5
Washita Series	Gray lime	390	395	5
	Blue shale	395	400	5
	Gray lime	400	430	30
	Blue shale	430	435	5
	Gray lime	435	440	5
	Blue shale	440	445	5
	Gray lime	445	450	5
	Blue shale	450	475	25
	Gray lime	475	482	7
	Blue shale	482	520	38
	White lime	520	530	10
	Blue shale set 12½ inches	530	585	55
Goodland	White lime	585	605	20
	Blue shale	605	615	10
	Sand, top of Trinity 120 feet without break	615	735	120
	Red bed	735	739	4
	White sand	739	850	111
	Red bed	850	855	5
	White sand	855	905	50
	Red bed	905	910	5
	White sand set 10 inches	910	960	50
	Red bed	960	975	15
	White sand	975	1060	85
	Red bed	1060	1070	10
	White sand	1070	1110	40
	Red bed	1110	1120	10
	White sand	1120	1210	90
Trinity Series	White lime	1210	1215	5
	Red bed	1215	1225	10
	Oil sand	1225	1228	3
	Blue shale	1228	1233	5
	White shale	1233	1236	3
	Red bed	1236	1240	4
	Blue shale	1240	1245	5
	White sand	1245	1300	55
	Red bed	1300	1310	10
	White sand	1310	1370	60
	Light shale	1370	1380	10
	Light sand bottoms	1380	1400	20

Trinity set 10 inches at 1400 feet

		Depth in Feet		
		From	To	Thickness
	Blue shale run 8 inches at 1400 feet	1400	1440	40
	Water sand	1440	1460	20
	Blue shale	1460	1600	140
	White sand	1600	1610	10
	Blue shale (gray shells)	1610	1710	100
	Whitesand (salt water)	1710	1730	20
	Blue shale (gray shells)	1730	1800	70
	White sand (water)	1800	1810	10
	Hard lime	1810	1815	5
	Blue shale	1815	1825	10
	White lime	1825	1830	5
	Blue shale	1830	1840	10
	Gray lime	1840	1850	10
	Blue shale	1850	1865	15
	Gray lime	1865	1875	10
	Dark shale, very cavey	1875	1900	25
	White sand (water)	1900	1920	20
	Blue shale (gray shells)	1920	1970	50
	White sand (water)	1970	1995	25
Pennsylvanian Series	Blue shale	1995	2035	40
	Light sand (water)	2035	2050	15
	Blue shale	2050	2080	30
	White sand	2080	2110	30
	Blue shale	2110	2160	50
	White sand	2160	2180	20
	Blue shale	2180	2210	30
	Light sand	2210	2220	10
	Blue shale	2220	2265	45
	OIL SAND	2265	2268	3
	Sand (salt water)	2268	2280	12
	Blue shale, rotten	2280	2310	30
	Water sand	2310	2335	20
	Blue shale	2335	2385	50
	Water sand	2385	2415	30
	Red bed	2415	2425	10
	Blue shale	2425	2430	5
	Light sand	2430	2450	20
	Blue shale	2450	2480	30
	Light sand left 8 inches at 2500 feet	2480	2510	30
	Blue shale	2510	2570	60
	Light sand run 6⅝ underreaming	2570	2600	30
	Blue shale	2600	2660	60
	Gray lime	2660	2665	5

		Depth in Feet		
		From	To	Thickness
	Blue shale	2665	2675	10
	White sand	2675	2700	25
	Blue shale	2700	2710	10
	Light shale	2710	2715	5
	White sand (hard)	2715	2745	30
	Gray sandy lime	2745	2751	6
Pennsylvanian Series	Soft white shale	2751	2776	25
	Lime shell, gray	2776	2777	1
	White shale, soft	2777	2781	4
	Red shale, soft	2781	2792	11
	Brown shale, soft	2792	2795	3
	Blue shale, soft	2795	2800	5
	Gray sandy lime, hard	2800	2804	4
	White shale, soft	2804	2810	6
	Blue shale, soft	2810	2882	72
	Gray lime, hard	2882	2904	22
	White shale, soft	2904	2908	4
	Blue shale, soft	2908	2985	77
	White shale, soft	2985	3038	53
	Blue shale, soft	3038	3066	28
	White shale, soft	3066	3081	15
	Blue shale, soft	3081	3095	14
	White shale, soft	3095	3097	2
	White sand, hard	3097	3113	16
	White shale, soft	3113	3152	39
	Blue shale, soft	3152	3230	78
	Gray lime, hard	3230	3239	9
	Red rock, hard	3239	3247	8
	Red rock, soft	3247	3254	7
	White sand, hard	3254	3281	27
	Gray lime, hard	3281	3291	10
	White sand, hard	3291	3298	7
	White shale, soft	3298	3327	29
	White sand, hard	3327	3338	11
	White shale, hard	3338	3350	12
	Red rock, soft	3350	3354	4
	White shale, soft	3354	3359	5
	Red shale, soft	3359	3408	49
	Gray lime, hard	3408	3419	11
	Red rock, soft	3419	3423	4
	Gray lime, hard	3423	3429	6
	OIL AND GAS SAND	3429	3439	10
	Blue shale	3439	3443	4
	Gray sand, soft	3443	3465	22
	Gray lime, hard	3465	3478	13
	Black sandy shale	3478	3480	2

		Depth in Feet		
		From	To	Thickness
Pennsylvanian Series	Blue lime, hard	3480	3485	5
	Blue shale, soft	3485	3497	12
	Gray lime, hard	3497	3503	6
	Black shale, hard	3503	3507	4
	Sandy shale, hard	3507	3512	5
	Sand, Gas and oil broken	3512	3519	7
	Sand, GAS and OIL	3519	3521	2

DAYTON NO. 1, SHASTA OIL COMPANY

Located on F. H. Dayton farm, Cooke County School Land Survey, 728 feet from the south line of the farm and 747 feet from the east line, on the east 50 acres of Block 26, 10 miles south and 4 miles east of Gainesville, Texas. Elevation, 759 feet. Cored at 2121 and at 2126–27 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Surface and sand	0	5	5
Clay and sand	5	11	6
Gravel	11	14	3
Soft sand	14	29	15
Lime rock	29	33	4
Hard shale and sand shells	33	149	116
Sandy lime	149	154	5
Sand and shale	154	196	42
Sandy lime	196	199	3
Sand and shale	199	244	45
Brown lime and shale	244	274	30
Sand, shale and lime	274	300	26
Brown lime, sand and shale	300	339	39
Hard shale and lime shells	339	395	56
Lime broken	395	460	65
Brown lime	460	511	51
Sandy shale and lime shells	511	622	111
Sand and shale	622	672	50
Water sand	672	702	50
Sand and shale	702	708	6
Brown lime	708	772	64
Hard sand and lime	772	800	28
Sand water	800	832	32
Brown lime and sand	832	847	15
Sandy lime	847	854	7
Dry sand white	854	859	5
Sticky red shale and sand shells	859	889	30

	Depth in Feet		
	From	To	Thickness
Black shale and lignite	889	901	12
Sand water	901	929	28
Brown lime	929	934	5
Sandy shale, gray	934	950	16
Red shale	950	970	20
Sand and sandy lime	970	986	16
Sandy lime	986	994	8
Sandy shale	994	1015	21
Sticky shale and lime shells	1015	1027	12
Sticky red shale	1027	1055	28
Sand	1055	1060	5
Hard sand and shale	1060	1065	5
Brown sand, shells and red shale	1065	1076	11
Lime, sandy	1076	1078	2
Blue shale	1078	1087	9
Red shale	1087	1099	12
Brown sand and shale	1099	1110	11
Red and pink shale	1110	1127	17
Sand water	1127	1144	17
Brown sand and clear gravel	1144	1149	5
Sand, gravel and shale	1149	1163	4
Red sticky shale	1163	1165	2
Lime shell	1165	1166	1
Sticky shale	1166	1180	14
Sandy shale	1180	1185	5
Red sticky shale	1185	1195	10
Brown sand and shale	1195	1218	23
Sandy shale	1218	1228	10
Sticky shale	1228	1241	13
Sand and shale	1241	1246	5
Sandy lime shell and shale	1246	1260	14
Sand water	1260	1276	16
Brown lime	1276	1282	6
Brown shale	1282	1286	4
Water sand and gravel	1286	1310	24
Sand water	1310	1322	12
Shale and lime shells, pink	1322	1330	8
Lime rock	1330	1334	4
Sandy shale, pink	1334	1342	8
Brown sand and shale, brown	1342	1352	10
Sandy shale, brown	1352	1356	4
Sticky shale, red	1356	1360	4
Brown lime	1360	1368	8
Sandy shale, brown	1368	1388	20

	Depth in Feet		
	From	To	Thickness
Brown sand	1388	1397	9
Sticky shale, blue	1397	1405	8
Sandy shale and brown sand	1405	1420	15
Sandy shale	1420	1436	16
Hard shale and shells	1436	1441	5
Brown sand (dry)	1441	1448	7
Sandy shale	1448	1462	14
Brown sandy lime	1462	1465	3
Hard crystallized sand	1465	1466	1
Blue shale	1466	1469	3
Sand	1469	1471	2
Sandy shale	1471	1474	3
Sand (dry), brown	1474	1476	2
Hard shale and shells	1476	1480	4
Sticky shale	1480	1482	2
Sandy, dry, bluish	1482	1484	2
Sandy shale	1484	1488	4
Lime	1488	1490	2
Brown lime sand and shale, brown	1490	1496	6
Sandy shale, gray	1496	1508	12
Lime shell, gray	1508	1509	1
Sticky shale, blue	1509	1521	12
Hard sand	1521	1522	1
Crystallized sand	1522	1525	3
Sand broken (dry), brown	1525	1530	5
Sand, dry	1530	1536	6
Sand to sandy lime	1536	1540	4
Sand and shale, alternating	1540	1562	22
Hard sand (dry), gray	1562	1571	9
Sandy lime	1571	1573	2
Sticky shale	1573	1580	7
Sticky shale, blue and gray	1580	1606	26
Dry sand, gray	1606	1610	4
Shale, pink and red	1610	1620	10
Sand, brown	1620	1628	8
Sticky shale, blue	1628	1630	2
Sticky shale	1630	1633	3
Lime	1633	1636	3
Sandy shale	1636	1645	9
Sticky shale	1645	1653	8
Lime	1653	1654	1
Brown lime and shale, blue	1654	1660	6
Brown sand	1660	1663	3
Sand to sandy lime	1663	1666	3

	Depth in Feet		
	From	To	Thickness
Sandy lime, crystallized	1666	1667	1
Hard sand	1667	1668	1
Hard sand and pyrites of iron	1668	1670	2
Hard lime, pyrites of iron	1670	1671	1
Brown lime	1671	1674	3
Gumbo	1674	1679	5
Hard lime	1679	1681	2
Lime, very hard and sandy	1681	1685	4
Sticky shale and shells, blue	1685	1702	17
Brown lime and shale	1702	1707	5
Sandy lime	1707	1712	5
Hard sand, dry	1712	1715	3
Sandy shale	1715	1718	3
Sandy lime	1718	1723	5
Sharp sand, gray-white	1723	1732	9
Sand and lime	1732	1734	2
Hard lime	1734	1739	5
Gumbo	1739	1744	5
Sticky shale and shells, blue	1744	1760	16
Lime, gray	1760	1763	3
Shale, red	1763	1768	5
Lime, gray	1768	1769	1
Sand and lime, dry	1769	1784	15
Hard sand	1784	1787	3
Hard shale and sand	1787	1790	3
Sandy lime	1790	1802	12
Sticky shale	1802	1826	24
Brown lime and shale	1826	1831	5
Sticky shale	1831	1842	11
Lime shells and shale	1842	1844	2
Sand (dry), gray	1844	1852	8
Hard shale, sandy	1852	1858	6
Sticky shale, lime shells, blue	1858	1874	16
Hard sandy shale	1874	1882	8
Sandy lime	1882	1890	8
Hard shale and sand	1890	1897	7
Sandy lime, gray	1897	1905	8
Sticky shale, blue	1905	1912	7
Hard sandy shale, gray	1912	1918	6
Sticky shale and lime shells, blue	1918	1930	12
Hard sandy shale	1930	1936	6
Sandy lime	1936	1938	2
Hard shale and lime	1938	1953	15
Hard sand, good showing oil	1953	1956	3

	Depth in Feet		
	From	To	Thickness
Hard sand, slight showing oil	1956	1959	6
Hard sand, white	1959	1965	6
Hard shale and lime shells	1965	.1969	4
Lime shells	1969	1975	6
Sticky shale, blue	1975	1978	3
Hard lime	1978	1980	2
Hard shell of lime	1980	1984	4
Shale, sandy	1984	1985	1
Sandy lime (steel line measure)	1985	1995	10
Sandy lime	1995	2000	5
Hard shale and shells	2000	2017	17
Gumbo	2017	2046	29
Hard sandy shale, gray	2046	2052	6
Shale and shells, blue	2052	2079	27
Sandy shale, gray	2079	2089	10
Shale, blue	2089	2100	11
Sticky shale and boulders	2100	2114	14
Lime (Ellenburger)	2114	2148	34
T. D. steel line measurement	2148		

Description of Sample by O. M. Richey and E. H. Sellards

	Depth in Feet
Two small pieces of a core of medium gray compact limestone. In thin section the limestone was seen to be finely crystalline and cut by two or three small fracture lines. Probably Ellenburger	2114

JAMES E. DAYTON NO. 1, ABERNATHY OIL OPERATOR

Location beginning at the southeast corner of the E. Hundt farm, thence north 1320 feet, thence east 2310 feet, thence south 150 feet to well, 6 miles south of Gainesville, Texas. Elevation, 735 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Surface clay	0	37	37
Lime shells	37	50	13
Clay	50	60	10
Shale and lime shells	60	216	156
Lime	216	268	52
Water sand	268	308	40

	Depth in Feet		
	From	To	Thickness
Sandy shale	308	556	248
Sand	556	680	124
Lime	680	686	6
Shale and lime shells	686	780	94
Water sand	780	875	95
Broken sand and lime shells	875	1047	172
Sticky shale	1047	1077	30
Hard sand	1077	1080	3
Shale and lime shells	1080	1089	9
Broken sand	1089	1109	20
Lime	1109	1111	2
Shale and lime shells	1111	1239	128
Blue shale	1239	1257	18
Shale and lime shells	1257	1281	24
Hard lime	1281	1283	2
Broken sandy lime	1283	1290	7
Sand	1290	1308	18
Sandy shale	1308	1319	11
Shale and sandy lime shells	1319	1340	21
Shale	1340	1348	8
Blue shale	1348	1356	8
Sandy lime	1356	1361	5
Pink shale	1361	1367	6
Sandy lime	1367	1370	3
Blue shale	1370	1387	17
Broken shells and shale	138	1389	2
Lime showing oil	1389	1390	1
Broken sand and lime shells, carrying oil saturation	1390	1468	78
Lime	1468	1470	2
Sticky shale	1470	1546	76
Sandy lime	1546	1549	3
Shale	1549	1550	1
Sand, showing oil	1550	1571	21
Shale and lime shells	1571	1588	17
Hard sandy lime	1588	1592	6
Blue shale	1592	1596	4
Shale and lime shells	1596	1602	6
Pink shale	1602	1626	24
Gray sand	1626	1630	4
Sandy lime	1630	1633	3
Sandy shale	1633	1638	5
Lime	1638	1640	2
Shale	1640	1653	13

	Depth in Feet From	To	Thickness
Lime	1638	1640	2
Shale	1640	1653	13
Lime	1653	1655	2
Pink and blue shale	1655	1671	16
Lime	1671	1675	4
Shale	1675	1677	2
Lime	1677	1680	3
Shale	1680	1683	3
Lime	1683	1684	1
Shale	1684	1709	25
Sand showing oil	1709	1719	10
Lime	1719	1721	2
Pink and blue shale	1721	1770	49
Broken sandy lime	1770	1798	28
Sand showing oil	1798	1806	8
White sand	1806	1814	8
Sandy lime	1814	1826	12
Sand showing oil	1826	1829	3
Water sand	1829	1848	19
Lime	1848	1851	3
Sandy shale	1851	1857	6
Shale	1857	1862	5
Lime	1862	1875	13
Shale and lime shells	1875	1877	2
Pink and blue shells	1877	1885	8
Lime shells	1885	1887	2
Gumbo	1887	1902	15
Sandy lime	1902	1910	8
Sandy shale	1910	1920	10
Hard shale	1920	1926	6
Hard lime	1926	1962	36

Description of Samples by O. M. Richey and J. A. Udden

Depth in Feet

A piece of core of medium brownish-gray dolomitic limestone in which small areas of lighter gray limestone, which effervesced freely in cold dilute hydrochloric acid, were noted. In thin section the rock was seen to be a medium crystalline dolomite containing some coarse crystalline areas. Indistinct traces of organic structures were noted in the finer crystalline areas. This rock is without doubt Ordovician and we

	Depth in Feet
refer it to the Ellenburger which is more or less equivalent to the Arbuckle limestone in Oklahoma. We have never found limestone of this kind in any formation above the Ellenburger in North Texas east of the eastern boundary of the Permian	1962

A. M. DOVE NO. 1, JORDAN CREEK OIL COMPANY

Located three and one-half miles east and four miles south of Woodbine, approximately on the Cooke-Grayson County line. Northeast part Hiram Coffee Survey.

Driller's Log

	Depth in Feet		
	From	To	Thickness
No notation	0	193	193
Rock	193	198	5
Shale	198	233	35
Rock	233	275	42
Sandy shale	275	295	20
Rock	295	300	5
Pack sand	300	368	68
Rock	368	425	57
Hard shale	425	440	15
Gravel rock	440	480	40
Sand	480	490	10
Boulders	490	500	10
Chalk rock	500	532	32
Lime rock	532	605	73
Sandy shale	605	610	5
Rock	610	615	5
Pack sand	615	665	50
Sandy shale	665	716	51
Coarse white sand	716	735	19
Rock	735	777	42
Rock	777	815	38
Sandy shale	815	868	53
Sandy lime	868	887	19
Sandy lime and shale	887	930	43
Lime rock	930	940	10
Sandy shale and lime	940	970	30
Gumbo and shale	970	990	20
Hard sand	990	1010	20
Sandy shale	1010	1020	10
Shale and gumbo	1020	1035	15

	Depth in Feet From	To	Thickness
Sandy shale	1035	1080	45
Shale and boulders	1080	1108	28
Rock	1108	1130	22
Sandy shale and boulders	1130	1155	25
Rock	1155	1165	10
Shale	1165	1175	10
Shale and boulders	1175	1180	5
Shale and boulders and sand	1180	1205	25
Hard sand	1205	1215	10
Shale and boulders	1215	1255	40
Gumbo	1255	1260	5
Water sand	1260	1270	10
Rock	1270	1278	8
Shale	1278	1285	7
Rock	1285	1290	5
Sandy shale	1290	1300	10
Boulders and rock	1300	1307	7
Sandy lime	1307	1327	20
Shale and gravel	1327	1332	5
Rock	1332	1334	2
Sandy shale	1334	1372	38
Gypsum gumbo	1372	1420	48
Sand, shale and boulders	1420	1446	26
Pack sand	1446	1461	15
Gumbo	1461	1469	8
Gumbo and shale	1469	1477	8
Lime rock	1477	1481	4
Hard sandy shale	1481	1488	7
Lime rock	1488	1492	4
Sandy shale	1492	1500	8
Sand rock	1500	1530	30
Soft sand	1530	1534	4
Hard sand	1534	1536	2
Flint sand	1536	1547	11
Sand	1547	1550	3
Sand rock and lime	1550	1595	45
Sandy lime	1595	1596	1
Lime rock	1596	1614	18
Sandy lime	1614	1616	2
Gypsum gumbo	1616	1654	38
Hard shale	1654	1655	1
Sandy lime	1655	1659	4
Hard sand	1659	1666	7
Rock	1666	1707	41

	Depth in Feet		
	From	To	Thickness
Sand rock	1707	1727	20
Shale and boulders	1727	1730	3
Sandy lime and shale	1730	1739	9
Shale and boulders	1739	1767	28
Sandy shale	1767	1817	50
Soft shale	1817	1830	13
Hard yellow rock	1830	1842	12
Gypsum gumbo	1842	1855	13
Sandy shale and lime	1855	1875	20
Sandy rock	1875	1887	12
Shale and gumbo	1887	1902	5

Description of Samples by E. B. Stiles

	Depth in Feet
Dark slightly calcareous shale of fine texture. *Globigerina* noted in washed material	1485–1490
A lump of yellowish-brown, fine-grained ferruginous sandstone. The shape of the fragments suggest a concretion. After heating to a red heat much of the material becomes magnetic. No fossils were seen. In closed tube faint ammonia fumes noted. Comanchean (?)	1620

Description of Sample by O. M. Richey and J. A. Udden

	Depth in Feet
A piece of core of compact light gray limestone. In thin section *Orbulina* and spinose *Globigemina* were noted, depth unknown.	
Several small pieces of light gray limestone in which some crystalline areas were noted. In the fragment sectioned the greater part of the rock was seen to be medium crystalline	1500?
A small piece of light gray fine-textured limestone in which a small crystalline area was seen	1574
A small piece of dark gray non-calcareous shale. Subangular to rounded grains of clear quartz, fragments of white calcareous material, and some pyrite noted in the washed material	1700
Small fragments from a core of medium gray sandstone. In thin section the sandstone was seen to be coarse-grained	1730

	Depth in Feet
A piece of medium gray, sandy, non-calcareous shale taken from the bit	1840
Likesample from 1840 feet. Probably Trinity	1902

E. FETTE NO. 1, HARRY HANBURY

Located on the B. H. Campbell Survey, on the E. Fette 50-acre farm, being 287.5 feet from west line, 444⅓ feet from the south line and 222⅓ feet from the north boundary Elm Creek, 3 miles south of Muenster. Elevation, 911 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Sand surface (Trinity)	0	100	100
Sand rock	100	210	110
Sand and lime shells	210	280	70
Sand	280	300	20
Sand and lime shells	300	410	110
Sticky shale	410	430	20
Sandy shale	430	450	20
Sand and lime shells	450	510	60
Red and brown shale	510	550	40
Brown sand and lime	550	576	26
Sandy lime	576	584	8
Shale	584	590	6
Lime	590	595	5
Hard sandy lime	595	613	18
Sand and shale	613	631	18
Shale and lime shells	631	645	14
Blue and brown shale	645	675	30
Lime	675	690	15
Sand (cored dry)	690	700	10
Brown sand and shale (cored dry)	700	710	10
Blue shale (cored)	710	728	18
Hard lime (cored)	728	740	12
Lime (cored)	740	743	3
Sand (cored dry)	743	760	17
Lime (cored)	760	763	3
Blue shale (cored)	763	840	77
Brown lime and blue shale (cored)	840	910	70
Hard sandy lime	910	912	2
Hard sticky blue shale	912	1012	100
Brown lime and shale	1012	1039	27
Sandy shale	1039	1050	11

	Depth in Feet		
	From	To	Thickness
Gumbo	1050	1060	10
Hard sandy shale and lime	1060	1097	37
Sandy lime	1097	1100	3
Brown sand and shale (cored dry)	1100	1109	9
Sand (cored dry)	1109	1116	7
Lime (cored)	1116	1122	6
Brown lime and shale (cored)	1122	1137	15
Hard shale and lime shells	1137	1217	80
Sticky gumbo, blue	1217	1230	13
Lime	1230	1237	7
Shale and lime shells	1237	1277	40
Brown sand	1277	1285	8
Shale and lime	1285	1322	37
Lime and sand	1322	1338	16
Lime	1338	1341	3
Sticky shale	1341	1350	9
Lime	1350	1355	5
Hard brown lime	1355	1374	19
Hard white lime	1374	1376	2
Brown sand	1376	1378	2
Soft sand	1378	1380	2
Sand (cored dry)	1380	1389	9
Brown shale and lime	1389	1449	60
Brown sand and lime	1449	1470	21
Shale and lime	1470	1494	24
Lime	1494	1500	6
Hard lime and shale	1500	1523	23
Black shale	1523	1536	13
Hard black shale	1536	1558	22
White lime	1558	1562	4
Hard black shale	1562	1595	33
Hard shale and brown lime	1595	1616	21
Brown lime and sand (cored dry)	1616	1621	5
Brown lime and shale	1621	1659	38
Hard shale	1659	1661	2
Hard lime	1661	1701	40
Red shale	1701	1732	31
Hard shale, streaks of sand and lime	1732	1760	38
Hard shale and lime	1760	1785	25
Hard sandy lime	1785	1792	7
Hard shale and lime	1792	1818	26
Brown lime	1818	1823	5
Lime	1823	1830	7
Hard shale and lime and streaks of sand	1830	1848	18

	Depth in Feet		
	From	To	Thickness
Sandy lime	1848	1858	10
Hard sandy lime (cored dry)	1858	1874	16
Lime	1874	1883	9
Hard lime and shale	1883	1914	31
Hard brown lime	1914	1939	25
Brown sand and shale	1939	1946	7
Hard shale and lime	1946	1951	5
Brown lime and shale	1951	1967	16
Ellenburger (Arbuckle, cored)	1967	2032	65
Total depth.			

Description of Sample by E. M. Hawtof and E. H. Sellards.

	Depth in Feet
Cuttings of dark gray non-calcareous shale and light gray crystalline dolomitic limestone. Of six fragments thin sectioned, five were seen to be finely crystalline and one coarsely crystalline	2002
Probably Ellenburger.	

FLORENCE NO. 1, CRANFILL & REYNOLDS (GODLEY PETROLEUM COMPANY)

Located on Fannin County school lands, Block 63, approximately 8 miles north and 6 miles east of Gainesville.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Surface	0	36	36
Rock	36	39	3
Red clay	39	45	6
Clay and gumbo	45	75	30
Sandy rock	75	77	2
Shale	77	107	30
Sandy rock	107	110	3
Shale and gumbo	110	154	44
Broken lime	154	182	28
Gyp and lime	182	212	30
Hard lime	212	215	3
Shale and rock	215	245	30
Broken lime	245	250	5
Shale and lime rock	250	325	75
Broken lime	325	355	30

	Depth in Feet From	To	Thickness
Hard lime, broken	355	388	33
Shale and gumbo	388	450	62
Gumbo and shale	450	520	70
Broken lime	520	530	10
Sandy lime	530	560	30
Red beds	560	580	20
Sandy rock	580	592	12
Hard sandy shale	592	650	58
Red beds	650	690	40
Hard sandy shale	690	715	25
Sandy lime	715	725	10
Sandy shale	725	780	55
Sandy rock	780	783	3
Red beds	783	801	18
Hard shale	801	850	49
Lime rock	850	852	2
Hard lime	852	855	3
Sandy shale	855	900	45
Sandy lime	900	920	20
Sandy shale	920	927	7
Sandy rock	927	937	10
Sandy lime rock	937	939	2
Sand rock	939	946	7
Hard shale	946	970	24
Lime rock	970	972	2
Hard rock	972	982	10
Red bed	982	1002	20
Sandy shale	1002	1022	20
Sandy lime	1022	1035	13
Sand rock	1035	1055	20
Sand rock	1055	1070	15
Red beds	1070	1107	37
Sandy rock	1107	1152	45
Green shale and gyp	1152	1166	14
Red beds and lime shells	1166	1197	31
Red beds	1197	1209	12
Sandy lime	1209	1221	12
Sandy rock	1221	1228	7
Red beds	1228	1240	12
Sandy lime	1240	1242	2
Sandy rock	1242	1243	1
Sandy shale	1243	1250	7
Red beds	1250	1275	25
Sandy shale	1275	1305	30

	Depth in Feet From	To	Thickness
Sandy lime	1305	1308	3
Sandy shale	1308	1335	27
Lime rock	1335	1337	2
Red beds	1337	1360	23
Sandy shale	1360	1380	20
Sandy lime	1380	1402	22
Missing	1402	1420	18
Hard sandy shale	1420	1440	20
Pack sand	1440	1455	15
Sand	1455	1470	15
Sandy shale	1470	1490	20
Shale	1490	1540	50
Gumbo	1540	1550	10
Lime rock	1550	1554	4
Hard sandy shale	1554	1600	46
Sandy lime	1600	1612	12
Gumbo	1612	1641	29
Sandy rock	1641	1643	2
Sandy shale	1643	1680	37
Gumbo	1680	1708	28
Sandy shale	1708	1720	12
Sandy shale and lime rock	1720	1742	22
Lime rock	1742	1747	5
Gumbo and sandy shale	1747	1767	20
Sandy shale	1767	1774	7
Lime shell	1774	1823	49
Gypsum	1823	1829	6
Gyp and gumbo	1829	1849	20
Gypsum	1849	1875	26
Gumbo	1875	1905	30
Hard sand and shale	1905	1915	10
Hard shale and lime shells	1915	1945	30
Shale	1945	1965	20
Lime ribs	1965	1975	10
Sandy shale and gumbo	1975	2005	30
Gypsum	2005	2040	35
Sand, shale and lime ribs	2040	2070	30
Hard shale and lime ribs	2070	2110	40
Sand, shale and lime ribs	2110	2130	20
Sand, lime	2130	2140	10
Hard sand lime	2140	2147	7
Shale	2147	2150	3
Sandy shale and gumbo	2150	2175	25
Shale and lime ribs	2175	2205	30

	Depth in Feet		
	From	To	Thickness
Shale and gumbo	2205	2275	70
Shale	2275	2290	15
Gypsum	2290	2305	15
Shale	2305	2350	45
Gypsum and gumbo	2350	2360	10
Sandy gumbo	2360	2375	15
Shale and lime ribs	2375	2400	25
Ribs and sand lime	2400	2414	14
Shale	2414	2424	10
St. shale and lime	2424	2436	12
Gumbo	2436	2449	13
Shale	2449	2490	41
Lime ribs and shale	2490	2518	28
Shale and lime ribs	2518	2528	10
Gumbo	2528	2538	10
Shale and lime ribs	2538	2448	10
Lime ribs and shale	2448	2568	20
Shale	2568	2608	40
Red bed and ribs	2608	2628	20
Sandy ribs	2628	2640	12
Gypsum	2640	2645	5
Sandy lime	2645	2670	25
Sandy lime, brown	2670	2699	29
Sandy lime	2699	2709	10
Sandy shale	2709	2729	20
Gypsum and gumbo	2729	2742	13
Gypsum	2742	2754	12
Gypsum and sandy gumbo	2754	2778	12
Gypsum	2778	2788	10
Gyp and gumbo	2788	2805	17
Gypsum	2805	2814	9
Hard shale and lime ribs	2814	2837	23
Shale and lime ribs	2837	2842	5
Shale, rock and gypsum	2842	2860	18
Hard sand, lime	2860	2870	10
Gumbo	2870	2877	7
Gumbo and gypsum	2877	2882	5
Gumbo and sandy lime ribs	2882	2910	38
Gyp and gumbo	2910	2918	8
Shale and sand, lime ribs	2918	2940	22
Hard shale and sandy lime ribs	2940	2980	40
Red rock	2980	3013	33
Gray shale	3013	3040	27
Gray shale and sand lime ribs	3040	3062	22

	Depth in Feet		
	From	To	Thickness
Gumbo	3062	3068	6
Shale and sand lime ribs	3068	3082	14
Hard sand	3082	3085	3
Gray shale	3085	3088	3
Hard sandy lime	3088	3092	4
Tough gumbo	3092	3105	13
Gypsum	3105	3109	4
Hard shale	3109	3117	8
Hard shale and sandy lime ribs	3117	3125	8
Hard gyp and shale	3125	3177	52
Gypsum	3177	3181	4
Hard shale and lime	3181	3187	6
Gumbo and hard shale	3187	3197	10
Gumbo and lime ribs	3197	3213	16
Gypsum	3213	3215	2
Sandy lime	3215	3220	3
Sand	3220	3224	4
Hard shale	3224	3229	5
Sand lime, hard 3233, sand lime	3229	3230	1
Sand	3230	3234	4
Sand, shale	3234	3235	1
Hard shale and sand	3235	3244	9
Shale—bbls. up	3244	3254	10
Hard sand, shale	3254	3256	2
Sandy lime	3256	3262	6
Sandy shale	3262	3272	10
Shale and sandy ribs	3272	3278	6
Lime and shale	3278	3281	3
Sandy lime	3281	3286	5
Shale	3286	3289	3
Sandy lime	3289	3292	3
Hard shale and lime ribs	3292	3332	40
Soft shale and lime ribs	3332	3374	2
Red rock	3374	3376	2
Soft lime	3376	3380	4
Hard shale and sandy lime ribs	3380	3405	25
Sandy lime	3405	3412	7
Shale	3412	3418	6
Shale and lime ribs	3418	3425	7
Red beds	3425	3470	45
Sandy lime	3470	3480	10
Shale and lime shells	3480	3525	45
Red beds and lime ribs	3525	3540	15
Shale and lime ribs	3540	3552	12

HIRE AND SEAGRAVES NO. 1, PETROLEUM INVESTMENT COMPANY

Located on Harriet Nail Survey, approximately 2 miles south of Hood, Texas. Elevation, 974 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Clay	0	10	10
Lime	10	13	3
Clay	13	20	7
Lime	20	24	4
Broken sand	24	50	26
Lime	50	55	5
Broken lime	55	65	10
Lime rock	65	73	8
Broken shale	73	78	5
Lime rock	78	85	7
Broken shale	85	93	8
Gumbo	93	105	12
White lime	105	110	5
Broken shale	110	155	45
Lime rock	155	170	15
Broken shale	170	182	12
Water sand	182	205	13
Sand	205	240	35
Gumbo	240	270	30
White sand	270	280	10
Broken shale	280	285	5
Lime rock	285	295	10
Water sand	295	305	10
Lime rock	305	317	12
White sand	317	330	13
Blue shale	330	340	10
White sand	340	375	35
Shale	375	387	12
Sand	387	395	8
Shale	395	408	13
Red shale	408	435	27
Lime shells	435	438	3
Gray shale	438	470	32
Lime rock	470	475	5
Broken shale	475	495	20
Lime rock	495	510	15
Sand	510	530	20

	Depth in Feet		
	From	To	Thickness
Gumbo	530	550	20
Sand	550	568	18
Shale	568	580	12
Sand	580	590	10
Hard shell	590	592	2
Sand	592	604	12
Red shale	604	610	6
Hard shale	610	628	18
Soft sand	628	660	32
Hard sand	660	670	10
Sand	670	682	12
Shale	682	687	5
Hard sand	687	695	8
Gravel	695	700	5
Quicksand	700	705	5
Broken sand	705	710	5
Red shale	710	735	25
Red rock	735	750	15
Blue shale	750	768	18
Water sand	768	787	19
Broken sand	787	810	23
Sand and gravel	810	835	25
Sand gravel	835	865	30
Sand	865	870	5
Broken shale	870	940	70
Sandy shale	940	965	25
Coarse sand and lime	965	1025	60
Sand and lime gas	1025	1060	35
Fine water sand	1060	1065	5
Sand and lime	1065	1075	10
Water sand	1075	1145	70
Lime and sand	1145	1155	10
Blue shale	1155	1337	182
Light sand oil show	1337	1347	10
Lime	1347	1349	2
Blue shale	1349	1350	1
Sandy shale	1350	1355	5
Blue shale	1355	1370	15
Shale and lime	1370	1382	12
Lime	1382	1385	3
Broken lime and shale	1385	1395	10
Broken lime, blue shale	1395	1400	5
Sand	1400	1430	30
Sticky shale	1430	1440	10

	Depth in Feet		
	From	To	Thickness
Blue shale	1440	1445	5
Shale and lime	1445	1460	15
Slate	1460	1495	35
Sandy lime	1495	1515	20
Hard lime	1515	1615	100
Loose lime	1615	1642	27

Total depth.

Casing Record: 20 -inch set at 285 feet.
15½-inch set at 685 feet.
12½-inch set at 1017 feet.
10 -inch set at 1397 feet.
8¼-inch set at 1620 feet.

Description of Samples by O. M. Richey and E. H. Sellards

	Depth in Feet
Cuttings of white, coarsely crystalline dolomite. A few angular fragments of white chert and a little pyrite were noted in the washed material. Two fragments in the thin section were seen to be coarsely crystalline, containing rhomb-shaped crystals, dark in the interior but with an external clear layer. A third fragment was seen to be almost wholly crystalline. Narrow veins of crystalline material observed	1615
Sample consists of fine cuttings of white crystalline dolomite. A few angular fragments of white chert were noted in the washed material	1635

Probably Ellenburger.

HUNDT NO. 1, HEDRICK CAMP DRILLING COMPANY AND JACK ABERNATHY

Located in the southwest corner of the Francis Godley Survey, being in the rectangle portion of the survey, 7 miles south of Gainesville. Elevation, 752 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Surface	0	18	18
Sand and clay	18	60	42
Lime and shale	60	200	140
Lime	200	215	15

	Depth in Feet		
	From	To	Thickness
Sand and lime	215	230	15
Shale	230	235	5
Clay and sand	235	250	15
Water sand	250	310	60
Clay	310	318	8
Sand and clay	318	370	52
Sand	370	460	90
Sand and shale	460	680	220
Shale	680	700	20
Sand	700	724	24
Sand and lime	724	804	80
Sand	804	845	41
Water sand	845	885	40
Sand	885	910	25
Shale	910	920	10
Sand	920	940	20
Sand and lime	940	941	1
Sandy lime, hard	941	942	1
Sand	942	950	8
Shale	950	964	14
Sandy lime	964	967	3
Shale	967	977	10
Sand	977	980	3
Sand and gravel	980	1030	50
Hard sand	1030	1040	10
Shale	1040	1050	10
Soft sand	1050	1062	12
Hard lime	1062	1064	2
Sand	1064	1076	12
Shale and sand	1076	1135	59
Sandy lime	1135	1147	12
Shale and shells	1147	1191	44
Sand	1191	1196	5
Shale	1196	1204	8
Sand and shale	1204	1221	17
Sandy lime	1221	1226	5
Hard shale and lime shells	1226	1240	14
Blue shale	1240	1279	39
Sandy lime	1279	1282	3
Sand	1282	1287	5
Sandy lime	1287	1291	4
Sand	1291	1296	5
Shale	1296	1304	8
Sand	1304	1314	10

	Depth in Feet From	To	Thickness
Broken sand	1314	1335	21
Sand	1335	1339	4
Lime	1339	1340	1
Sand and shale and broken lime	1340	1365	25
Blue and red shale	1365	1381	16
Lime	1381	1382	1
Lime and chalk	1382	1392	10
Lime and sand and shale	1392	1400	8
Sandy lime and shale	1400	1417	17
Hard lime	1417	1418	1
Blue sticky shale	1418	1422	4
Shale	1422	1445	23
Sandy shale	1445	1446	1
Sandy lime	1446	1455	9
Sand	1455	1465	10
Sandy shale	1465	1473	8
Sand	1473	1475	2
Shale	1475	1480	5
Sandy lime	1480	1496	16
Sandy lime and shale	1496	1532	36
Shale and sand and lime	1532	1542	10
Shale	1542	1550	108
Sandy shale	1550	1558	8
Sandy lime	1558	1565	7
Sandy shale	1565	1571	6
Sandy lime	1571	1576	5
Sandy lime and shale	1576	1614	38
Red formation	1614	1622	8
Sand	1622	1623	1
Red beds	1623	1653	30
Lime	1653	1660	7
Dry sand	1660	1683	23
Sand	1683	1722	39
Shale	1722	1725	3
Sand	1725	1726	1
Blue shale	1726	1746	20
Broken lime	1746	1763	17
Sandy shale	1763	1770	7
Dry sand	1770	1776	6
Sand	1776	1800	24
Sand, lime and shale	1800	1823	23
Shale	1823	1825	2
Shale and lime sand	1825	1855	30
Tough shale	1855	1860	5

	Depth in Feet		
	From	To	Thickness
Lime, hard top	1860	1869	9
Lime, hard	1869	1874	5
Hard lime	1874	1914	40
S. L. M. T. D. D. and A.	1914	1915	1

Description of Samples by O. M. Richey and E. H. Sellards

	Depth in Feet
A core of medium gray moderately coarse-grained, calcareous sandstone. Pennsylvanian	1772
A piece of a core of very dark gray to black limestone cut by extremely thin calcite veins. A few small fossils were noted when the core was examined microscopically. In thin section several very narrow calcite veins were noted. Fragments of organic remains present. Bend?	1889
Sample consists of a core of light gray limestone cut by several thin seams of calcite. In thin section the limestone showed a blotchy texture in which coarsely crystalline areas were separated by more or less granular streaks and areas. Ellenburger	1915

KITCHENS NO. 1, VACUUM OIL COMPANY

Located approximately one mile east of Callisburg, Texas, on Block No. 1248, Lot No. 9. Elevation, 834 feet. Casing record: Rotary, 12½-inch set at 161 feet; 9-inch set at 3278 feet; 6⅝-inch set at 3470; 4¾-inch set at 370. Water sands: at 677 feet to 1200 feet; 1804 feet to 1889 feet; 3861 feet to 3867 feet. Oil showings at 3444 feet to 3670 feet (chiefly shale); dry sands, 3743 feet to 3746 feet (dry); dry sands, 3840 feet to 3848 feet (dry). Salty water was noted in the thin lenses at 3848 feet to 3934 feet. No gas was observed in this well.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Surface sands and clay	0	30	30
Sand rock	30	36	6
Sand	36	50	14
Sands	50	161	111
Sand rock	161	164	3
Hard shale and boulders	164	245	81

	Depth in Feet From	To	Thickness
Sand rock	245	289	44
Shale and boulders	289	309	20
Lime rock	309	314	5
Shale and boulders	314	336	22
Hard sand rock	336	338	2
Hard shale and boulders	338	374	36
Broken lime	374	398	24
Shale	398	428	30
Lime rock	428	433	5
Shale and boulders (hard shale)	433	480	47
Shale and boulders	480	509	29
Lime and chalk	509	530	21
Shale	530	536	6
Hard lime	536	575	39
Lime rock	575	584	9
Sandy lime rock	584	605	21
Shale and boulders	605	677	72
Trinity sand	677	1200	523
Lime rock	1200	1205	5
Gumbo	1205	1215	10
Hard sand	1215	1261	46
Sand, shale and lime	1261	1341	80
Sand rock	1341	1346	5
Sand	1346	1357	11
Shale	1357	1375	18
Sandy shale	1375	1408	33
Shale	1408	1437	29
Sand	1437	1466	29
Shale	1466	1478	12
Hard sand	1478	1490	12
Shale and boulders	1490	1576	86
Lime and sand	1576	1583	7
Sticky shale	1583	1609	26
Lime	1609	1635	26
Sand rock	1635	1642	7
Shale	1642	1649	7
Hard sandy shale	1649	1656	7
Hard white sand	1656	1680	24
Sand and lime	1680	1710	30
Lime and shale	1710	1720	10
Water sand	1720	1741	21
Sticky shale	1741	1767	26
Hard lime	1767	1770	3
Sandy limey shale	1770	1775	5

	Depth in Feet		
	From	To	Thickness
Sticky shale	1775	1795	20
Sandy lime rock	1795	1804	9
Water sand	1804	1809	5
Shale and lime	1809	1836	27
Hard sand	1836	1850	14
Sticky shale	1850	1865	15
Hard lime	1865	1885	20
Shale and lime	1885	1903	18
Lime rock	1903	1908	5
Shale	1908	1925	17
Shale and lime	1925	1932	7
Sticky shale	1932	1956	24
Lime rock	1956	1958	2
Sticky shale	1958	2173	215
Sand rock	2173	2178	5
Hard sand	2178	2186	8
Hard limey shale	2186	2199	13
Hard sand	2199	2255	56
Shale	2255	2304	49
Lime	2304	2308	4
Hard limey shale	2308	2347	39
Sand rock	2347	2349	2
Hard sandy shale	2349	2404	55
Sand rock	2404	2413	9
Hard sandy shale	2413	2440	27
Hard shale lime and sand	2440	2499	59
Hard sandy shale	2499	2521	22
Hard sand	2521	2524	3
Hard shale and lime	2524	2557	33
Hard sandy limey shale	2557	2621	64
Hard lime	2621	2627	6
Hard sand	2627	2640	13
Hard shale	2640	2661	21
Hard sandy shale	2661	2684	23
Hard sandy shale	2684	2712	28
Red bed	2712	2718	6
Hard red shale	2718	2728	10
Hard red limey shale	2728	2731	3
Sticky blue shale	2731	2817	86
Sticky shale	2817	2827	10
Lime rock	2827	2832	5
Hard shale	2832	2858	26
Hard shale and lime	2858	2958	100
Sand rock	2958	2972	14

	Depth in Feet From	To	Thickness
Hard sandy shale	2972	2988	16
Hard shale and lime	2988	3000	12
Lime and sand rock	3000	3006	6
Shale	3006	3011	5
Shale and lime	3011	3050	39
Lime	3050	3057	7
Hard sandy lime	3057	3070	13
Hard sandy shale	3070	3092	22
Hard shale and lime	3092	3165	73
Shale and lime	3165	3168	3
Hard white sand and shale	3168	3175	7
Shale and lime	3175	3191	16
Sandy lime	3191	3196	5
Sandy lime rock	3196	3199	3
Red shale	3199	3209	10
Blue and red shale	3209	3227	18
Hard sand	3227	3248	21
Hard white sand	3248	3250	2
Sand rock	3250	3252	2
Sandy lime rock	3252	3257	5
Hard shale	3257	3278	21
Hard limey shale	3278	3313	35
Hard lime and shale	3313	3350	37
Hard shale	3350	3357	7
Hard lime	3357	3367	10
Hard lime	3367	3369	2
Hard lime, sandy	3369	3372	3
Sandy lime	3372	3374	2
Hard shale and lime shells	3374	3385	11
Shale	3385	3405	20
Sand	3405	3407	2
Hard sand and shale	3407	3422	15
Sand	3422	3432	10
Sandy shale	3432	3442	10
Sand	3442	3444	2
Black shale	3444	3485	41
Sandy shale with thin streaks of sand showing oil	3485	3519	34
Hard sand, slight show oil	3519	3522	3
Hard sand, slight show of oil	3522	3529	7
Sandy shale, slight show oil	3529	3538	9
Sandy shale	3538	3540	2
Shale set 3471 feet of 6⅝-inch casing and bailed dry, show oil	3540	3544	4

	Depth in Feet		
	From	To	Thickness
Sandy shale, slight show oil	3544	3546	2
Sandy shale	3546	3628	82
Hard slaty shale	3628	3635	7
Hard sandy shale	3635	3644	9
Sandy shale	3644	3670	26
Sandy shale, slight show oil	3670	3674	4
Sandy shale bailed hole dry	3674	3679	5
Sandy shale	3679	3704	25
Soft gray lime	3704	3719	15
Gray lime	3719	3722	3
Red shale	3722	3725	3
Gray lime	3725	3728	3
Black shale and lime	3728	3737	9
Black shale and lime	3737	3743	6
Oil sand	3743	3746	3
Sandy shale and lime	3746	3751	5
Sand and lime	3751	3753	2
Set 23 feet perforated pipe, bailed oil and salt water, shot and bailed oil and salt water.			
Sandy shale	3753	3755	2
Hard shale	3755	3759	4
Shale lime and sand	3759	3763	4
Shale	3763	3773	10
Hard sand	3773	3774	1
Hard sand and shale	3774	3781	7
Shale	3781	3787	6
Sandy shale	3787	3790	3
Shale	3790	3796	6
Black shale and gray sand	3796	3799	3
Red shale	3799	3801	2
Sandy shale	3801	3805	4
Red shale	3805	3809	4
Sandy limey shale	3809	3810	1
Sandy shale	3810	3812	2
Shale	3812	3816	4
Sand and red shale	3816	3822	6
Blue shale	3822	3825	3
Shale and sand and lime	3825	3832	7
Sandy lime shale	3832	3836	4
Red shale and lime	3836	3840	4
Lime and shale (slight show 3844–3848 feet)	3840	3848	8
Hard sand and shale	3848	3849	1
Sandy shale	3849	3854	5
Shale	3854	3861	7

	Depth in Feet		
	From	To	Thickness
Salt water sand	3861	3867	6
Shale	3867	3873	6
Sand and shale, slight show 3880–3884 feet	3873	3884	11
Hard sandy lime	3884	3886	2
Shale, blue	3886–	3901	15
Sandy shale	3901	3917	16
Hard sand	3917	3926	9
Hard blue shale	3926	3930	4
Red shale and lime	3930	3934	4
Blue shale	3934	3938	4
Shale and white sand	3938	3942	4
Sand shale	3942	3952	10
Sticky bluish shales (streaked with shaly sand lenses)	3952	4310	358

LUDERMAN NO. 1, SUN OIL COMPANY

Located on the N. R. Sparks Survey, 100 feet south and 425 feet west of the northeast corner of the Luderman 640 acres, 8 miles north and 1 mile east of Myra. Elevation, 909 feet. Abandoned at 3334 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Surface shells and clay	0	20	20
Sand dry	20	40	20
Hard sand	40	65	15
Sand	65	95	30
Gray sand; two bailers of water per hr. at 115 feet	95	130	35
Blue shale	130	133	3
Gray lime sand	133	157	24
Red mud	157	160	3
Lime	160	165	5
Sandy lime	165	170	5
White sand	170	176	6
Gravel and sand	176	187	9
Pink sand	187	200	13
Sand	200	210	10
Red rock	210	215	5
Sandy lime	215	240	25
Blue shale	240	265	25
White sand (water)	265	300	35
Sand (hole full of water)	300	340	40

	Depth in Feet		
	From	To	Thickness
Lime	340	370	30
Sand	370	400	30
Sand (hole full of water	400	450	50
Sand	450	460	10
Sandy shale	460	485	25
Sandy lime	485	510	25
Red beds	510	513	3
Sandy lime	513	518	5
Lime	518	522	4
Sand	522	528	6
Sandy lime	528	565	37
Sand	565	600	35
Sandy lime	600	602	2
Red rock	602	610	8
Gray shale	610	615	5
Sandy shale	615	644	29
Blue shale	644	685	41
Water sand	685	690	5
Blue shale (hole full water)	690	707	17
White sand	707	710	3
Sand	710	715	5
Blue shale	715	730	15
Sand, hard	730	740	10
Shale	740	745	5
Blue shale	745	753	8
Sandy shale	753	765	12
Hard sandy lime	765	783	18
Lime sand	783	790	7
Blue shale	790	793	3
Sand	793	820	27
Sandy shale	820	833	13
Blue shale	833	982	149
Sandy lime	982	1000	18
Shale and lime shells	1000	1023	23
Lime, gray	1023	1038	15
Red beds	1038	1043	5
Blue shale	1043	1056	13
Sandy shale	1056	1066	10
Shale	1066	1068	2
Sand	1068	1086	18
Blue shale	1086	1088	2
Sand	1088	1090	2
Shale	1090	1100	10
Gray mud	1100	1107	7

	Depth in Feet		
	From	To	Thickness
Lime	1107	1115	8
Blue shale	1115	1120	5
Shale	1120	1135	15
Sandy shale	1135	1170	35
Sand, dry	1170	1190	20
Blue shale	1190	1215	25
Shale	1215	1230	15
Blue shale	1230	1235	5
Shale	1235	1240	5
Sandy shale	1240	1245	5
Sandy lime	1245	1250	5
Shale	1250	1262	12
Blue shale	1262	1267	5
Shale	1267	1269	2
Sand	1269	1279	10
Shale	1279	1287	8
Blue shale	1287	1302	15
Shale	1302	1317	15
Blue shale	1317	1325	8
Red beds	1325	1335	10
Sandy lime	1335	1338	3
Shale	1338	1358	20
Sandy lime	1358	1390	32
Hard sand	1390	1400	10
Shale	1400	1405	5
Sandy shale	1405	1420	15
Sand	1420	1430	10
Shale and sand	1430	1437	7
Sand and water	1437	1470	33
Hard sand	1470	1480	10
Shale	1480	1495	15
Sandy lime	1500	1510	10
Blue shale	1510	1550	40
Blue shale	1527	1550	23
Shale	1550	1570	20
Blue shale	1570	1590	20
Shale	1590	1595	5
Sandy lime	1595	1612	17
Blue shale	1612	1615	3
Hard sandy lime	1615	1620	5
Sandy lime	1620	1629	9
Shale	1629	1660	31
Shale gray	1660	1695	35
Gray sandy lime	1695	1707	12

	Depth in Feet From	To	Thickness
Gray shale	1707	1724	17
Sandy shale	1724	1740	16
Shale	1740	1776	36
Gray shale	1776	1792	16
Blue shale	1792	1809	17
Shale	1809	1825	16
Blue shale	1825	1827	2
Lime	1827	1832	5
Blue shale	1832	1835	3
Shale	1835	1871	36
Shale lime shells	1871	1875	4
Shale shells	1875	1897	22
Shale	1897	1912	15
Lime	1912	1919	7
Blue shale	1919	1927	8
Shale	1927	1937	10
Blue shale	1937	1945	8
Shale	1945	1966	21
Sandy shale	1966	1989	33
Shale	1989	2000	11
Sand	2000	2006	6
Blue shale	2006	2012	6
Water sand	2012	2021	9
Shale	2021	2027	6
Blue shale	2027	2039	12
Shale	2039	2051	12
Shale	2051	2062	12
Water sand	2062	2075	13
Lime	2075	2077	2
Water sand	2077	2083	6
Blue shale	2083	2094	11
Sand	2094	2102	8
Water sand	2102	2145	43
Shale	2145	2150	5
Shale and lime	2150	2155	5
Shale	2155	2165	10
Sand	2165	2184	19
Hard sand	2184	2194	10
Shale	2194	2196	2
Sand	2196	2230	34
Shale	2230	2235	5
Sandy lime	2235	2240	5
Sand	2240	2250	10
Soft lime	2250	2255	5

	Depth in Feet		
	From	To	Thickness
Sandy shale	2255	2270	15
Shale and sandy lime shells	2270	2330	60
Gray shale	2330	2395	65
Shale	2395	2415	20
Water sand	2415	2435	20
Gray water sand	2435	2440	5
Water sand	2440	2455	15
Blue shale	2455	2480	25
Shale	2480	2490	10
Hard sand	2490	2500	10
Shale	2500	2505	5
Hard sand	2505	2515	10
Shale	2515	2525	10
Blue shale	2525	2540	15
Shale	2540	2550	10
Sand	2550	2555	5
Shale	2555	2558	3
Blue shale	2558	2573	15
Shale	2573	2588	15
Blue shale	2588	2605	17
Shale	2605	2617	12
Blue shale	2617	2623	6
Sand	2623	2630	7
Shale	2630	2639	9
Sand	2639	2644	5
Shale	2644	2667	23
Blue shale	2667	2678	11
Shale	2678	2691	13
Sandy lime	2691	2716	25
Blue shale	2716	2739	23
Shale	2739	2750	11
Sand, dry	2750	2762	12
Sandy shale	2762	2780	18
Sand	2780	2790	10
Sandy shale	2790	2795	5
Sand	2795	2835	40
Sand, dry	2835	2860	25
Lime, hard	2860	2874	14
Lime	2874	2900	26
Hard sand	2900	2930	30
Hard sand and lime	2930	2936	6
Hard sand	2936	2941	5
Lime	2941	2951	10
Gray lime	2951	2965	14

	Depth in Feet		
	From	To	Thickness
Hard lime	2965	2983	18
Lime	2983	2996	13
Hard lime	2996	3020	24
Sandy lime	3020	3080	60
Sand (water at 3100 feet)	3080	3105	25
Sand	3105	3114	9
Sandy lime	3114	3124	10
Lime	3124	3177	53
Lime (hole caving)	3177	3182	15
Lime	3182	3241	59
Sandy lime	3241	3246	5
Hard lime	3246	3251	5
Hard sandy lime	3251	3256	5
Hard lime	3256	3263	7
Hard sandy lime	3263	3269	6
Hard lime	3269	3286	17
Lime	3286	3305	19
Sandy lime	3305	3310	5
Lime	3310	3332	22
Lime, hard	3332	3334	2
Top of Ellenburger probably between 2860 feet and 2874 feet.			

J. W. MOUNT NO. 1, McELREATH AND SUGGETT

Located J. W. Mount 640-acre farm, on S. P. R. R. Company Survey, well was drilled 1556 feet east and 150 feet north in southwest corner of Section No. 9, 4 miles south of Bulcher. Elevation, 1152 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Surface	0	22	22
Lime	22	68	46
Shale	68	83	5
Lime	83	92	9
Sandy shale	92	141	49
Sand	141	284	143
Lime	284	288	4
Sandy lime	288	300	12
Sandy shale	300	417	117
Sand and shale	417	548	131
Sand	548	581	33

	Depth in Feet		
	From	To	Thickness
Lime	581	584	3
Shale	584	608	24
Lime	608	615	7
Shale and lime shell	615	662	47
Lime	662	664	2
Sticky shale	664	720	56
Lime	720	724	4
Hard sand	724	734	10
Sticky shale	734	785	51
Sand, sharp	785	803	18
Sand	803	808	5
Gumbo	808	817	9
Sand	817	830	13
Shale and shells	830	856	26
Lime	856	867	11
Shale	867	878	11
Gumbo	878	895	17
Hard sand	895	900	5
Sharp sand	900	927	27
Hard sand	927	968	41
Sticky shale	968	996	28
Sticky shale	996	1058	62
Lime	1058	1065	7
Shale and shells	1065	1081	16
Shale	1081	1088	7
Sandy lime	1088	1099	11
Hard sand	1099	1107	8
Shale	1107	1109	2
Sand	1109	1133	24
Sandy lime	1133	1137	4
Gumbo	1137	1141	4
Sand	1141	1159	18
Lime	1159	1163	4
Shale	1163	1165	2
Sandy lime	1165	1170	5
Shale	1170	1173	3
Hard sand, rocky	1173	1178	5
Gumbo	1178	1182	4
Lime rock	1182	1184	2
Lime	1184	1186	2
Sandy shale	1186	1203	17
Sandy lime	1203	1211	8
Shale	1211	1220	9
Hard sand	1220	1236	16

	Depth in Feet From	To	Thickness
Brown lime	1236	1247	11
Shale and shell	1247	1275	28
Lime	1275	1285	10
Shale	1285	1291	6
Sand, shale and shell	1291	1337	46
Hard lime	1337	1344	7
Sticky shale	1344	1352	8
Lime	1352	1357	5
Sand; hard, dry, white, with brown streaks	1357	1372	15
Sandy lime	1372	1378	6
Sand and shale broken	1378	1405	27
Gumbo	1405	1420	15
Shale	1420	1474	54
Shale and shells	1474	1494	20
Shale and shells	1494	1512	18
Gumbo	1512	1523	11
Shale and shells	1523	1543	20
Sticky shale	1543	1560	17
Broken sandy lime, show oil	1560	1579	19
Lime rock	1579	1582	3
Sand, show oil	1582	1585	3
Sandy lime, show oil	1585	1587	2
Sandy shale, show oil	1587	1589	2
Hard lime	1589	1590	1
Sandy lime, show oil	1590	1607	17
Sandy shale and shells show oil	1607	1645	38
Shale	1645	1651	6
Sandy lime	1651	1654	3
Sand	1654	1657	3
Brown sand	1657	1682	25
Lime	1682	1690	8
Sandy shale, show oil	1690	1725	35
Sandy lime	1725	1726	1
Sticky shale	1726	1740	14
Brown sand and lime	1740	1750	10
Shale	1750	1761	11
Sandy lime	1761	1771	10
Sand	1771	1780	9
Lime	1780	1792	12
Shale and sand and lime	1792	1824	32
Brown shale and sandy lime	1824	1858	34
Brown sand and lime	1858	1892	34
Sticky shale	1892	1900	8
Hard sandy lime	1900	1920	20

	Depth in Feet From	To	Thickness
Hard lime	1920	2002	82
Hard lime	2002	2030	28
Brown lime	2030	2040	10
Hard lime	2040	2095	55
Total depth.			

Description of Sample by E. M. Hawtof and E. H. Sellards

	Depth in Feet
A piece of a core of brownish-gray, slightly dolomitic, somewhat fine-grained evenly-textured limestone. An irregular fracture in the rocks was partly filled with bituminous matter. In thin section the rock was noted to consist of a fine-grained matrix in which were small crystals	2095½

Pre-Pennsylvanian probably Ellenburger.

YOSTEN NO. 1, MUENSTER OIL COMPANY

Located one and one-fourth miles northwest of Muenster.

Driller's Log

	Depth in Feet From	To	Thickness
Lime	0	20	20
Yellow clay	20	55	35
Red rock	55	70	15
Lime	70	73	3
Water sand	73	95	22
Gray shale	95	165	70
Lime	165	175	10
Gray shale	175	205	30
Lignite	205	225	20
Denver mud	225	245	20
Water sand	245	270	25
Lime	270	275	5
Blue shale	275	345	70
Red rock	345	355	10
Gray putty	355	375	20
Lime	375	405	30
Gray putty	405	435	30
Red rock	435	460	25
Lime	460	485	25
Gray putty	485	515	30

	Depth in Feet		
	From	To	Thickness
Quicksand	515	522	7
Gray clay	522	570	48
Blue shale	570	585	15
Gray slate	585	641	56
Blue shale	641	750	109
Lime	750	754	4
Water sand	754	760	6
Blue shale	760	800	40
White lime	800	820	20
Water sand	820	830	10
Blue shale	830	895	65
Sandy lime, hard	895	915	20
Blue shale	915	980	65
Sandy lime	980	990	10
Gray shale	990	1000	10
Hard lime	1000	1015	15
Blue shale	1015	1060	45
Sand, gas	1060	1070	10
Blue shale	1070	1125	55
Hard lime	1125	1128	3
Blue shale	1128	1160	32
Hard lime	1160	1165	5
Sand, no water	1165	1180	15
Blue shale	1180	1205	25
Hard lime	1205	1235	30
Gray shale	1235	1315	80
Blue slate	1315	1380	65
Hard lime	1380	1400	20
Blue slate	1400	1425	25
Hard lime	1425	1445	20
Gray slate	1445	1452	7
Hard dry sand	1452	1477	25
Blue shale	1477	1490	13
Hard sand	1490	1520	30
Blue shale	1520	1527	7
Hard lime	1527	1532	5
Blue shale	1532	1570	38
Hard lime	1570	1575	5
Oil sand	1575	1595	20
Blue shale	1595	1660	55
Hard lime	1660	1670	10
Blue slate	1670	1680	10
Hard lime	1680	1690	10
Sand, dry	1690	1698	8

	Depth in Feet		
	From	To	Thickness
Blue slate	1698	1748	50
Sandy lime	1748	1758	10
Blue shale	1758	1790	32
Hard lime	1790	1810	20
Blue shale	1810	1855	45
Hard lime	1855	1865	10
Gray sand, dry	1865	1880	15
Blue shale	1880	1945	65
Hard lime	1945	1967	22
Oil sand, dry	1967	1977	10
Blue shale	1977	1997	20
Hard lime	1997	2012	15
Water sand	2012	2021	9
Hard lime	2021	2032	11
Water sand	2032	2052	20
Hard lime	2052	2077	25
Water sand, 3 feet oil sand at top	2077	2086	9
Sandy shale	2086	2101	15
Black shale	2101	2102	1
Black sand	2102	2105	3
Blue mud	2105	2106	1
Gray lime	2106	2124	18
Water sand	2124	2128	4
Hard lime	2128	2156	28
Water sand, salt	2156	2162	6
Hard lime	2162	2182	20
Water sand, salt	2182	2188	6
Sandy lime	2188	2195	7
Hard gray lime	2195	2212	17
Water sand, salt	2212	2217	5
Brown lime	2217	2296	79
Dry sand	2296	2298	2
Gray lime	2298	2336	38
White sand, gas	2336	2342	6
Gray lime, set ⅝	2342	2384	42
Sand, dry	2384	2395	11
Gray lime	2395	2409	14
White dry sand	2409	2417	8
Brown lime	2417	2425	8
Sand, oil, dry	2425	2437	12
Brown lime	2437	2451	14
Sand, dry, oil	2451	2458	7
Gray lime	2458	2468	10
Brown lime	2468	2475	7

	Depth in Feet From	To	Thickness
Sandy lime	2475	2491	16
Gray lime	2491	2512	21
Red rock	2512	2540	28
Gray lime	2540	2545	5
Red rock	2545	2551	6
Lime, brown, gray, red	2551	2560	9
Sand, dry	2560	2563	3
Gray lime	2563	2570	7
Red rock	2570	2575	5
Lime and sand	2575	2585	10
Hard gray lime	2585	2620	45
Black sandy lime and shale	2620	2716	96
Brown sandy lime	2716	2720	4
Black sandy carbon	2720	2724	4
Black sandy lime	2724	2820	96
Green black sandy lime	2820	2838	18
Gray sandy lime	2838	2875	37
Black sandy lime	2875	2985	110
Gray sandy lime	2985	3005	20
Black sandy lime	3005	3020	15
Gray sandy lime	3020	3048	28
Black sandy lime	3048	3055	7
Gray sandy lime	3055	3080	25
Black sandy lime	3080	3210	130
Gray sandy lime	3210	3235	20
Black sandy lime	3235	3275	40
Black sandy lime, fine	3275	3335	60
Gray sandy lime	3335	3350	15
Black sandy lime and shale, soft	3350	3382	32
Black sandy lime, hard	3382	3475	93
Black lime, very hard	3475	3491	16
Black or brown shale	3491	3540	49
Black sandy lime	3540	3578	38
Black-brown sand	3578	3652	74
Gray, very hard sand	3652	3670	22
Gray, very hard sand	3670	3790	20

Description of Samples by J. A. Udden

Depth in Feet

White sandstone with calcareous matrix, and a few fragments of white limestone of compact texture, and some black shale. In thin section the sandstone is seen to consist of grains of one-eighth mm. and

	Depth in Feet
less in diameter. No fumes in closed tube test. A concretion of clay-iron-stone present	1575–1595
Sample apparently consists of sandstone and white crystalline dolomite. Sample is insufficient in quantity for adequate description	1575–1595
White dolomite with some black carbonaceous shale, the latter evidently from above the limestone. In thin section the dolomite was seen to be crystalline. A few small fragments of green indurated shale noted. Evidently the Ellenburger	2005

Description of Samples by E. H. Sellards and O. M. Richey

	Depth in Feet
Cuttings of medium gray and reddish-brown glauconitic calcareous sandstone or sandy limestone. The reddish-brown material effervesces more freely with hydrochloric acid than does the gray. Probably Cambrian	2553–2560

Description of Samples by J. T. Lonsdale

	Depth in Feet
Cuttings from Standard rig. Minerals present: Quartz, approximately 50 per cent; hornblende and biotite, 40 per cent; feldspar (oligoclase andesine), 5 per cent; miscellaneous, including hematite, apatite, and other minerals, 5 per cent.	
Mineral characters: Quartz shows optical strain indicative of metamorphism; hornblende is the blue-green slightly pleochroic type characteristic of metamorphic rocks.	
Proportion of minerals: Quartz is too high in amount in comparison with feldspar, biotite, and hornblende to be igneous rock. Proportions, however, are often seen in schists and related rocks.	
Sample is from metamorphic rock, most likely a hornblende-mica-quartz schist, though it may be a slate or phyllite	2750

I. F. PIERCE NO. 1, PORTER-HOLMES

Located on the Barsheba Lusk Survey, two miles south and four miles east of Bulcher. Elevation, 914 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Sandy clay	0	10	10
Loose sand	10	29	19
Sand	29	51	22
Sand—fresh water	51	75	24
Red mucky sand—broken	75	79	4
Packed sand, hard streaks	79	183	104
Pink mucky sand—broken	183	224	41
Fine soft sand	224	245	21
Sand—hard streaks	245	314	69
Hard sand rock	314	320	6
Hard sand rock and lime	320	322	2
Sandy lime	322	323	1
Sand rock	323	325	2
Soapstone	325	336	11
Lime	336	340	4
Blue sandy gumbo	340	346	6
Sandy rock, very fine	346	351	5
Sand rock, sand, and gravel	351	365	14
Sand rock and gray lime	365	371	6
Pack sand—streaks of lime	371	388	17
Hard sand rock	388	390	2
Hard lime—sandy	390	392	2
Hard sandy lime	392	393	1
Tough yellow gumbo	393	403	10
Lime rock	403	404	1
Tough gumbo	404	410	6
Yellow gumbo	410	416	6
Shale, show of gas	416	444	28
Hard fine sand rock	444	449	5
Hard sand rock	449	455	6
Tough gumbo	455	461	6
Packed sand	461	483	22
Tough gumbo	483	493	10
Hard lime	493	495	2
Sandy lime	495	506	11
Broken sandy lime	506	508	2
Tough gumbo	508	530	22
Gray gumbo	530	540	10
Gumbo—streaks sand	540	544	4
Hard shale—streaks hard sand, cored	544	581	37
Shale—hard streaks sand	581	601	20
Sand rock	601	608	7
Blue tough gumbo	608	643	35

	Depth in Feet		
	From	To	Thickness
Gumbo	643	651	8
Hard shale	651	661	10
Rock	661	662	1
Sandy lime	662	663	1
Shale	663	669	6
Sandy lime	669	670	1
Shale	670	688	18
Soft gray sand lime	688	693	5
Hard shale and boulders	693	718	25
Tough gumbo	718	720	2
Blue gumbo	720	726	6
Hard shale	726	744	18
Shale—streaks sand	744	751	7
Gumbo	751	763	12
Shale	763	773	10
Sand rock	773	781	8
Gumbo	781	787	6
Gumbo	787	789	2
Shale	789	796	7
Shale, thin streaks sand	796	812	16
Gumbo	812	822	10
Sand and shale, very hard	822	842	20
Well shut down August 6, 1925.			
Gumbo	842	855	13
Hard sand	855	870	15
Sand rock	870	871	1
Hard lime	871	885	14
Sandy lime	885	892	7
Gumbo	892	940	48
Hard lime	940	970	30
Gumbo	970	980	10
Hard sand	980	983	3
Sandy lime—cored at 983 feet	983	1000	17
Sandy shale—streaks lime	1000	1042	42
Hard sand	1042	1072	30
Gumbo	1072	1075	3
Sand rock	1075	1076	1
Hard lime	1076	1092	16
Gumbo	1092	1110	18
Sandy lime	1110	1126	16
Broken lime	1126	1132	6
Gumbo	1132	1145	13
Shale, streaks of lime	1145	1170	25
Sandy lime	1170	1200	30

	Depth in Feet From	To	Thickness
Gumbo	1200	1240	40
Shale and lime	1240	1300	60
Sandy lime (cored at 1333 feet)	1300	1342	42
Broken lime and shale	1342	1380	38
Sandy lime	1380	1403	23
Lime rock	1403	1410	7
Gumbo	1410	1440	30
Sandy shale, streaks lime	1440	1460	20
Gumbo	1460	1475	15
Broken lime and shale	1475	1495	20
Gumbo	1495	1535	40
Broken lime and shale	1535	1555	20
Hard sand (cored at 1558 feet)	1555	1568	13
Shale and lime	1568	1580	12
Sandy lime	1580	1595	5
Hard lime	1595	1630	35
Broken lime and gumbo	1630	1640	10
Gumbo	1640	1655	15
Sandy shale and lime	1655	1670	15
Broken lime and shale	1670	1720	50
Sandy lime	1720	1768	48
Hard lime	1768	1785	17
Lime and shale	1785	1830	45
Shale and lime	1830	1870	40
Sand (cored) showing oil and salt water	1870	1884	14
Brown lime and shale	1884	1920	36
Hard sandy lime (cored at 1957feet)	1920	1958	1
Sandy shale and lime (cored at 1967, 1975, 1992 feet)	1958	1995	37
Hard shale and lime	1995	2000	5
Hard lime	2000	2025	25
Sandy lime	2025	2080	55
Hard lime	2080	2090	10
Lime and shale	2090	2098	8
Sandy shale and lime (cored at 2108 feet)	2098	2108	10
Hard lime	2108	2219	111
Ellenburger	2219	2225	6

Description of Sample by E. M. Hawtof and E. H. Sellards

	Depth in Feet
Sample consists of a piece of a core of brownish-gray dolomitic limestone, a large part of which is medium to coarsely crystalline. This core appears to represent Ellenburger	2225

THE TIPPIT AND DARNALL WELL

Located three miles north of Myra, Cooke County, Texas. D. E. Moss Survey. Elevation, 950 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
White lime	0	20	20
Black shale	20	40	20
White lime	40	90	50
Black shale	90	110	20
Soft blue sand	110	165	55
Water sand	165	185	20
White sand	185	300	115
White shale	300	320	20
White sand	320	365	45
White shale	365	400	35
White sandy shale	400	450	50
White mud	450	475	25
White soft sand	475	480	5
Black shale	480	700	220
Red rock	700	720	20
White lime	720	725	5
Oil sand	725	735	10
Red rock	735	745	10
Black shale	745	800	55
White sandy shale	800	890	90
Water sand	890	920	30
White sandy shale	920	955	35
White lime shell	955	960	5
Hard sand	960	975	15
White lime	975	1000	25
White shale and lime shells	1000	1060	60
White sandy shale	1060	1080	20
Black shale	1080	1180	100
White lime shells	1180	1185	5
Black shale	1185	1250	65
Salt sand	1250	1350	100
Black shale	1350	1370	20
Salt water sand	1370	1405	35
Black shale	1405	1535	75
Dry sand	1535	1590	55
Black shale	1590	1640	50
White lime	1640	1815	175
White lime with strong salt water	1815	1825	10

	Depth in Feet From	To	Thickness
White lime with sandy streaks interspersed, bearing salt water and the color changing nearly every screw	1825	2040	215
Sandy lime with green soap scattered through it; also black coal or something resembling same	2040	2050	10
Lime changing in color with salt water strata	2050	2385	315
Asphalt oil	2385	2388	3
Specimen submitted, white crystalline dolomite	2390	-------	2

A log submitted November, 1916, records white lime with sandy streaks from 1815 to 2059 feet and from 2059 to 2675 feet. This well was drilled to 3000 feet.

Description of Samples by J. A. Udden; Samples Submitted by J. S. Darnell, Denton, 1916

	Depth in Feet
Straw-colored, mostly crystalline, dolomitic limestone. Some fragments dissolve only in hot acid. Cuttings have a tendency to float on water, but no bituminous odor was noted on heating	2195
Straw-colored, crystalline, dolomitic limestone, all about equally soluble in acid. No fumes noted when heated. Some smooth and well-rounded grains of sand noted	2200
In its general appearance and behavior with acids, this rock resembles the Ordovician-Cambrian limestone (Ellenburger) of Central Texas, and the corresponding limestones in the Wichita Mountains in Oklahoma.	
Mostly dolomitic white limestone, with some limestone and very little sand. The sand is partly worn with grains from 1/16 to 1/4 mm. in diameter. When heated the limestone give a distinct bituminous odor. Small particles of asphalt seemed to be present. The limestone contains some fragments of oolitic structure, the spherules measuring about 1/50 mm. in diameter	2385
White dolomitic limestone of quite compact texture. A thin section was seen to consist of crystals of somewhat uniform size from 1/5 to 1/15 mm. in diameter. The sample contains some asphalt, which in one fragment was seen to be in a vein or flat cavity in	

	Depth in Feet
the rock, along the sides of which the limestone was quite coarsely cristalline. A single fragment of black shale was noted. The sample contains a few fragments of white flint	2390
White, finely crystalline dolomite. Small fragments of pure calcite were noted. Among the smallest fragments a number of minute spherules of calcite were noted, having a diameter of from 1/16 to 1/20 mm. and a dark central dot. In thin section one fragment was seen to have crystal grains of variable sizes. Heated in closed tube, the rock turns dark and emits faint odor of bitumen. The sample is mixed with a little dark clayey or soily material which appears to be foreign. It darkens the fragments of of rock, the true color of which appears when the sample is washed	2900

G. VOGAL NO. 1, SKINNER ET AL

Located on John Trussell Survey, 450 feet from most easterly point of east 53-acre tract of the Vogal farm, two miles southwest of Muenster. Elevation, 1030 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Lime	0	12	12
Lime and sand	12	30	18
Hard sand	30	34	4
Hard sand	34	246	212
Shale	246	252	6
Sand	252	494	242
Shale	494	550	56
Sand	550	615	65
Sandy lime	615	641	26
Sandy shale	641	690	49
Lime	690	694	4
Hard sand	694	720	26
Shale	720	730	10
Sand	730	737	7
Shale	737	741	4
Lime	741	745	4
Shale	745	751	6
Lime	751	755	4
Sticky shale	755	764	9
Sandy shale	764	801	37

	Depth in Feet From	To	Thickness
Shale	801	822	21
Sand	822	846	24
Sticky shale	846	867	21
Hard lime	867	872	5
Gumbo	872	971	99
Lime	971	973	2
Broken lime and sand	973	988	15
Sticky shale	988	990	2
Shale	990	1020	30
Broken lime	1020	1024	4
Gumbo	1024	1048	24
Broken lime	1048	1055	7
Sandy lime	1055	1066	11
Gumbo	1066	1070	4
Sandy lime	1070	1080	10
Hard lime	1080	1100	20
Lime (cored)	1100	1130	30
Gumbo	1130	1154	24
Shale	1154	1190	36
Sand	1190	1194	4
Shale	1194	1204	10
Gumbo	1204	1231	27
Sandy lime	1231	1236	5
Sandy shale	1236	1260	24
Gumbo	1260	1276	16
Sticky shale	1276	1307	31
Shale and shells	1307	1330	23
Gumbo sticky shale	1330	1367	37
Broken lime	1367	1374	7
Shale	1374	1377	3
Broken sand, brown	1377	1387	10
Gumbo	1387	1395	8
Sand	1395	1404	9
Shale	1404	1408	4
Sand	1408	1412	4
Sticky shale	1412	1418	6
Lime shells	1418	1425	7
Gumbo	1425	1429	4
Hard shale	1429	1430	1
Sticky shale	1430	1436	6
Broken sand	1436	1438	2
Sticky shale	1438	1461	23
Gumbo	1461	1486	25
Sticky shale	1486	1506	20

	Depth in Feet From	To	Thickness
Hard shale	1506	1510	4
Blue shale	1510	1525	15
Sticky shale	1525	1543	18
Hard shale	1543	1563	20
Sticky shale	1563	1583	20
Hard shale	1583	1593	10
Sticky shale	1593	1595	2
Hard broken lime	1595	1599	4
Dry sand	1599	1601	2
Gumbo	1601	1605	4
Sticky shale	1605	1615	10
Broken dry sand	1615	1620	5
Broken lime	1620	1638	18
Hard shale and shells	1638	1659	21
Sticky shale	1659	1664	5
Hard lime	1664	1667	3
Broken lime	1667	1685	18
Hard lime	1685	1686	1
Hard shale	1686	1690	4
Sticky shale	1690	1704	14
Lime	1704	1709	5
Gumbo	1709	1762	53
Sticky shale	1762	1766	4
Hard lime	1766	1780	14
Hard sand	1780	1784	4
Sandy shale	1784	1788	4
Sandy shale	1788	1800	12
Hard sand	1800	1804	4
Soft dry sand	1804	1807	3
Sandy shale	1807	1815	8
Sticky shale	1815	1830	15
Broken lime	1830	1845	15
Hard lime	1845	1847	2
Broken sand	1847	1851	4
Hard sand	1851	1868	17
Gumbo	1868	1884	16
Hard lime	1884	1889	5
Hard sand	1889	1899	10
Gumbo	1899	1919	20
Hard sandy lime	1919	1933	14
Shale	1933	1934	1
Gumbo	1934	1976	42
Hard sandy lime	1976	1983	7
Hard lime	1983	2036	53

	Depth in Feet		
	From	To	Thickness
Hard sandy lime	2036	2041	5
Gumbo	2041	2056	14
Broken sandy lime	2056	2060	4
Shale	2060	2063	3
Hard lime	2063	2092	29
Hard lime	2092	2100	8
Hard sand	2100	2110	10
Gumbo	2110	2116	6
Broken lime	2116	2126	10
Hard sand	2126	2136	10
Broken sandy lime	2136	2140	4
Hard sand	2140	2143	3
Hard lime	2143	2150	7
Hard lime (dolomite)	2150	2350	200

Description of Sample by O. M. Richey and E. H. Sellards

	Depth in Feet
Small pieces of a core of gray quartzite. In thin section the grains were seen to be uniform in size and shape	2036
Cuttings of grayish-blue shale and light brownish-gray dolomitic limestone. The limestone is coarsely crystallized. Many of the crystals have a clear exterior and a dense or granular interior. Seams of crystalline calcite were observed	2346

The formation represented by the sample at 2036 feet is not determined. The sample at 2346 feet represents the Ellenburger.

RUBY WALKER NO. 1, AMERADA PETROLEUM CORPORATION

Located on Ruby Walker 132-acre farm, Adam Dozier Survey, well was drilled in southwest part of farm, being 200 feet from the west line and 250 feet from the south line, which is the creek; two miles west of Gainesville. Elevation, 738 feet. Casing record: 20-inch set at 149 feet, 15½-inch set at 755 feet, 12½-inch set at 1078 feet, 10-inch set at 1832 feet, 8¼-inch set at 2463 feet, 6⅝-inch set at 2655 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Gravel—hole full water	0	19	19
Yellow clay	19	30	11
Blue shale	30	60	30

	Depth in Feet		
	From	To	Thickness
Hard sand	60	70	10
Blue shale	70	80	10
Broken shale	80	95	15
Hard lime	95	115	20
Lime	115	128	13
Blue shale	128	130	2
Water sand (HFW)	130	150	20
Blue shale	150	155	5
Sandy lime	155	158	3
Black shale	158	163	5
Lime	163	175	12
Sand, hard dry	175	195	20
Light blue shale	195	200	5
Sand and lime	200	210	10
Sandy lime	210	215	5
Soft water sand	215	255	40
Soft water sand	255	270	15
Sand	270	305	35
Red rock	305	320	15
Sand and shale	320	330	10
Water sand	330	355	25
Sandy shale	355	358	3
Sand	358	405	47
Sandy shale	405	420	15
Sandy lime	420	424	4
Sand and shale	424	438	14
Red rock	438	465	27
Sand water	465	480	15
Red rock	480	490	10
Lime, hard	490	500	10
Blue shale	500	505	5
Red rock	505	518	13
Lime, hard	518	525	7
Lime	525	528	3
Water sand	528	554	26
Lime	554	560	6
Sand	560	575	15
Sand	575	590	15
Blue shale	590	594	4
Red rock	594	612	18
Blue shale	612	615	3
Water sand	615	625	10
Water sand	625	647	22
Red rock	647	665	18

	Depth in Feet		
	From	To	Thickness
Water sand	665	745	80
Yellow shale	745	750	5
Water sand	750	765	15
Water sand	765	780	15
Blue shale	780	790	10
Red rock	790	804	14
Sandy shale	804	810	6
Blue shale	810	820	10
Water sand	820	832	12
Blue shale	832	835	3
Sand	835	837	2
Blue shale	837	840	3
Pink shale	840	850	10
Water sand	850	860	10
Brown shale	860	865	5
Lime, hard	865	870	5
Lime	870	876	6
Yellow clay	876	880	4
Red rock	880	895	15
Blue shale	895	948	53
Lime	948	956	8
Blue shale	956	1018	62
Lime	1018	1027	9
Blue shale	1027	1030	3
Blue shale, still drilling	1030	1038	8
Lime	1038	1040	2
Blue shale	1040	1060	20
Sandy shale	1060	1085	25
Water sand (HFW)	1085	1095	10
Blue shale	1095	1125	30
Sandy shale	1125	1170	45
Blue shale	1170	1210	40
Sandy lime	1210	1216	6
Lime and shale	1216	1223	7
Hard lime	1223	1230	7
Water sand (HFW)	1230	1250	20
Sand	1250	1270	20
Blue shale	1270	1278	8
Lime	1278	1282	4
Sandy lime	1282	1290	8
Water sand	1290	1298	8
Sandy shale	1298	1310	12
Blue shale	1310	1500	190
Water sand (HFW, 6 bbls. water)	1500	1505	5

	Depth in Feet		
	From	To	Thickness
Blue shale	1505	1528	23
Water sand	1528	1540	12
Lime and sand	1540	1550	10
Water sand	1550	1557	7
Blue shale	1557	1645	88
Sandy shale	1645	1670	25
Blue shale	1670	1745	75
Water sand	1745	1775	30
Sandy lime	1775	1783	8
Water sand	1783	1810	27
Blue shale	1810	1870	60
Sandy lime	1870	1874	4
Blue shale	1874	1880	6
Red rock	1880	1900	20
Water sand	1900	1912	12
Brown shale	1912	1922	10
Blue shale	1922	1930	8
Brown shale	1930	1950	20
Blue shale	1950	1978	28
Brown shale	1978	1990	12
Sandy lime	1990	2005	15
Sand	2005	2015	10
Lime	2015	2040	25
Sandy lime	2040	2063	23
Water sand	2063	2200	137
Hard sharp sand	2200	2245	45
Hard lime	2245	2258	13
Blue shale	2258	2315	57
Sandy lime	2315	2320	5
Hard water sand (HFW)	2320	2365	45
Hard sand	2465	2425	60
Sand and lime	2425	2430	5
Blue shale	2430	2455	25
Hard water sand (HFW)	2455	2472	17
Hard lime	2472	2490	18
Hard water sand (HFW)	2490	2530	40
Hard lime	2530	2580	50
Brown shale	2580	2605	25
Blue shale	2605	2665	60
Lime	2665	2880	215

STACEY NO. 1, MAGNOLIA PETROLEUM COMPANY

Located on the Jonathan Clark Survey, about 1550 varas west, and 1400 varas north of the southeast corner of the survey, four miles north of Gainesville. Elevation, 1030 feet.

Description of Sample by O. M. Richey and E. H. Sellards

	Depth in Feet
A piece of a core of brown dolomitic limestone. In thin section the limestone was seen to be finely crystalline. The crystals are almost perfect rhombs and are surrounded by a narrow external layer of colorless material. Ellenburger	1835–1845

MATTIE F. WILLIAMS NO. 1, CHARLES PETTIT ET AL.

Located 600 feet north and 534 feet east of the southwest corner of the west forty acres of the east sixty acres of Charles A. Mackay Survey; two and one-half miles south of Callisburg, Texas. Elevation, 863 feet.

Driller's Log

	Depth in Feet		
	From	To	Thickness
Surface	0	107	107
Hard shale	107	130	23
Lime rock	130	142	12
Lime shale	142	176	34
Lime shale and shell	176	232	56
Lime shale and gummy shale	232	292	60
Lime rock	292	298	6
Lime shale	298	320	22
Lime rock	320	324	4
Lime shale	324	343	19
Hard lime shale and shell	343	575	232
Lime shell and streaks of shale	575	600	25
Sand	600	627	27
Sandy gumbo	627	630	3
Lime and shale	630	670	40
Lime and sand	670	710	40
Pack sand	710	730	20
Sand and shale	730	760	30
Lime and sand	760	800	40
Water sand	800	830	30
Sandy gumbo	830	850	20
Sandy lime rock	850	890	40
Sandy gumbo	890	930	40
Sandy lime	930	975	45
Red bed	975	1000	25
Sandy shale	1000	1025	25
Broken lime	1025	1035	10

	Depth in Feet		
	From	To	Thickness
Hard sandy lime	1035	1126	91
Red bed	1126	1172	46
Sandy shale	1172	1217	45
Lime rock	1217	1223	6
Red bed	1223	1277	54
Blue shale	1277	1350	73
Sandy shale	1350	1370	20
Sandy lime rock	1370	1385	15
Shale	1385	1440	65
Gumbo	1440	1510	70
Shale	1510	1620	110
Broken lime	1620	1670	50
Gumbo	1670	1690	20
Shale	1690	1720	30
Broken lime	1720	1754	34
Lime rock	1754	1777	23
Gumbo	1777	1787	10
Broken lime	1787	1820	33
Hard sandy shale	1820	1870	50
Hard lime rock	1870	1878	8
Hard sandy shale	1878	1893	15
Gumbo	1893	1935	42
Hard lime	1935	1944	9
Gumbo	1944	1995	51
Shale	1995	2005	10
Gumbo	2005	2040	35
Broken lime	2040	2055	15
Gumbo	2055	2095	40
Broken lime	2095	2100	5
Gumbo	2100	2130	30
Lime	2130	2150	20
Broken lime and shale	2150	2175	25
Sandy lime	2175	2200	25
Sandy rock	2200	2205	5
Gumbo	2205	2220	15
Broken lime and shale	2220	2230	10
Sand and shale	2230	2260	30
Hard lime	2260	2265	5
Lime rock	2265	2280	15
Hard shale	2280	2300	20
Broken lime and shale	2300	2314	14
Lime rock	2314	2318	4
Hard sand and shale	2318	2329	11

	Depth in Feet		
	From	To	Thickness
Shale	2329	2378	49
Gumbo and lime	2378	2386	8
Hard lime	2386	2390	4
Gumbo and lime	2390	2404	14
Lime and gumbo	2404	2410	6
Sandy shale with boulders	2410	2470	60
Broken lime	2370	2480	10
Hard lime	2480	2498	18
Broken lime and shale	2498	2520	22
Lime rock	2520	2530	10
Lime and shale	2530	2545	15
Gyp	2545	2550	5
Lime and Gumbo	2550	2575	25
Gyp	2575	2587	12
Hard lime	2587	2595	8
Gumbo and broken lime	2595	2617	22
Gumbo and lime	2617	2642	25
Hard lime	2642	2660	18
Gumbo and lime	2660	2680	20
Sticky shale	2680	2710	30
Lime and shale	2710	2725	15
Lime rock	2725	2735	10
Lime	2735	2740	5
Broken lime and shale	2740	2761	21
Hard lime	2761	2769	8
Lime rock	2769	2775	6
Gumbo	2775	2806	31
Broken lime and shale	2806	2832	26
Sandy lime, hard	2832	2836	4
Hard sandy lime	2836	2838	2
Lime and shale	2838	2845	7
Pack sand (cored)	2845	2850	5
Hard sand	2850	2869	19
Sand rock	2869	2875	6
Hard sandy lime	2875	2893	18
Sandy lime	2893	2927	34
Sandy lime	2927	2930	3
Broken lime and shale	2930	2949	19
Hard sandy lime	2949	2952	3
Lime and shale	2952	2972	20
Gyp and shale	2972	3012	40
Lime rock	3012	3020	8
Gumbo and lime	3020	3037	17

	Depth in Feet From	To	Thickness
Gumbo	3037	3045	8
Gyp	3045	3055	10
Lime rock	3055	3070	15
Sandy lime	3070	3074	4
Lime and shale	3074	3094	20
Shale and lime	3094	3110	16
Lime rock	3110	3125	15
Broken lime and shale	3125	3142	17
Sandy lime	3142	3148	6
Pack sand (cored)	3148	3150	2
Pack sand	3150	3158	8
Sandy lime	3158	3182	24
Shale	3182	3188	6
Hard lime	3188	3196	8
Hard lime and shale	3196	3208	12
Broken lime	3208	3218	10
Sandy lime	3218	3227	9
Gumbo	3227	3235	8
Hard lime	3235	3248	13
Lime and gumbo	3248	3253	5
Lime rock	3253	3256	3
Broken lime and shale	3256	3276	20
Sand rock	3276	3285	9
Pack sand	3285	3295	10
Red bed	3295	3312	17
Gumbo	3312	3333	21
Hard lime	3333	3337	4
Lime and sticky shale	3337	3356	19
Sand rock	3356	3361	5
Lime and shale	3361	3390	29
Hard lime and shale	3390	3408	18
Sandy lime	3408	3428	20
Sandy shale	3428	3438	10
Sand and shale	3438	3448	10
Sticky shale	3448	3464	16
Sand	3464	3473	9
Sandy shale and lime	3473	3494	21
Sandy shale	3494	3515	21
Hard lime	3515	3530	15
Sandy lime	3530	3545	15
Sandy lime and shale	3545	3570	25
Lime and shale	3570	3600	30
Sticky shale	3600	3608	8

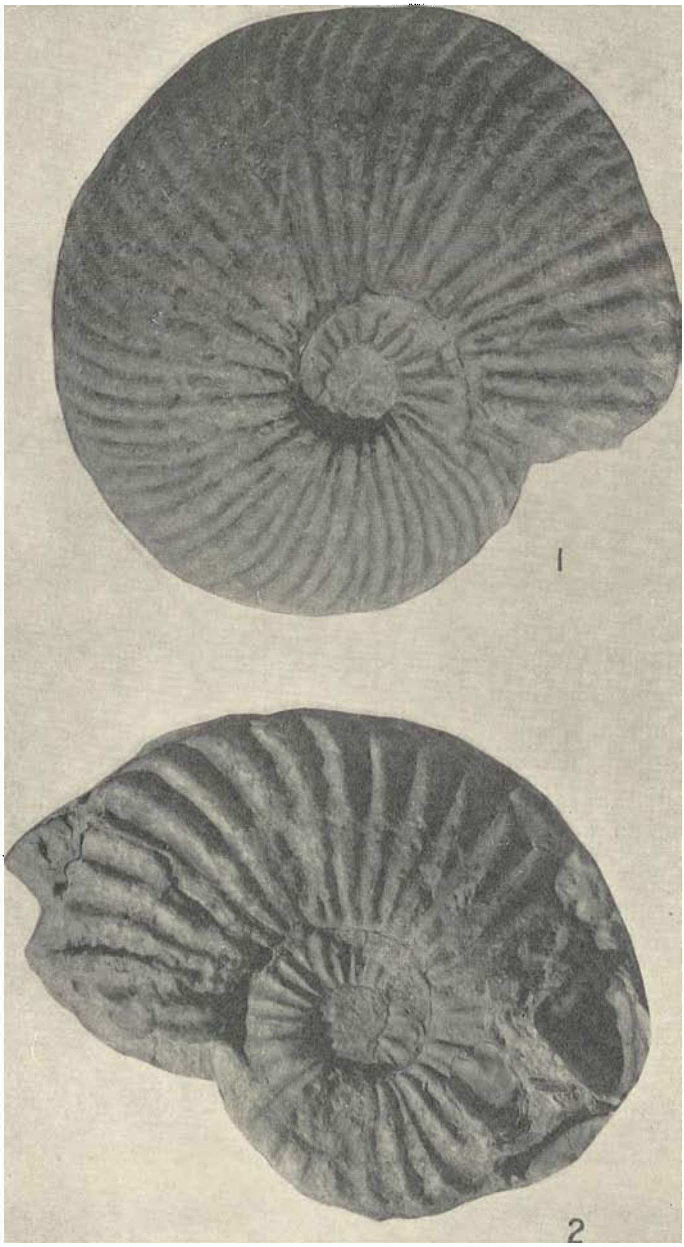


Fig. 1. *Schloenbachia acutocarinata* (Shumard); horizon, upper Goodland limestone; size, × 0.7.

Fig. 2. *Schloenbachia belknapi* (Marcou); horizon, upper Kiamichi clay ranging sparingly into the lower Duck Creek formation; size, × 0.5.

Plate III

Figs. 1–2. *Gryphea navia* Hall; horizon, Kiamichi clay; size, natural.

Fig. 3. Slab of shell conglomerate made up chiefly of *Gryphea navia* Hall; horizon, top of the Kiamichi clay; size, compare with hammer in picture.

(Photograph through courtesy of the United States Geological Survey.)

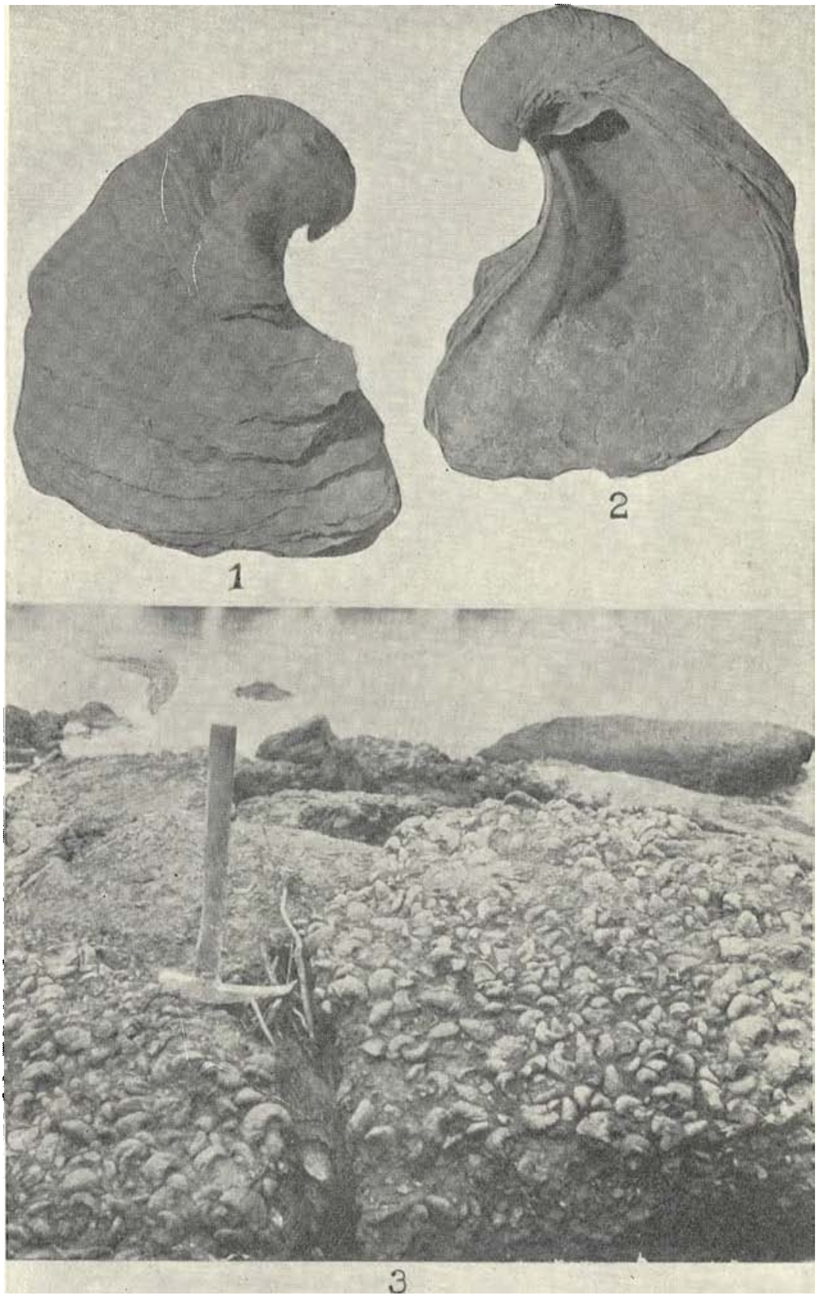

1
2
3

Plate IV

Fig. 1. *Desmoceras brazoense* (Shumard); horizon, lower Duck Creek formation 25 to 35 feet above the top of the Kiamichi clay; size, compare with 15-inch ruler in picture.

Fig. 2. *Inoceramus comancheanus* Cragin; horizon, lower Duck Creek formation, below "large ammonite" zone; size, × 0.8.

Fig. 3. *Schloenbachia trinodosa* Böse; horizon, upper part of lower Duck Creek formation; size, × 0.6.

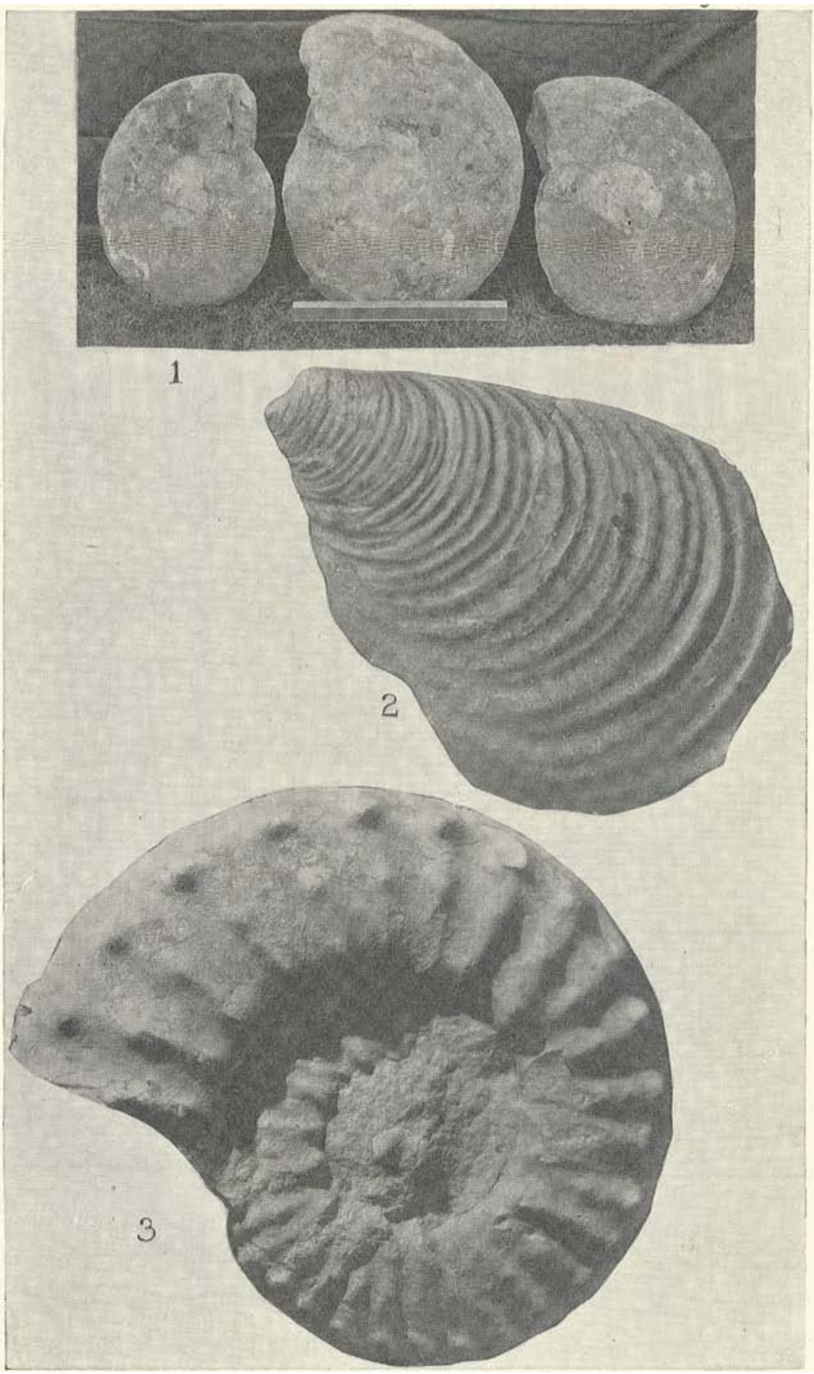

1
2
3

Plate V

Fig. 1. *Schloenbachia leonensis* Conrad; horizon, Fort Worth limestone; size, $\times$ 0.3.

Figs. 1–2. *Hemiaster elegans* Shumard; horizon, Fort Worth limestone; size, $\times$ 0.6.

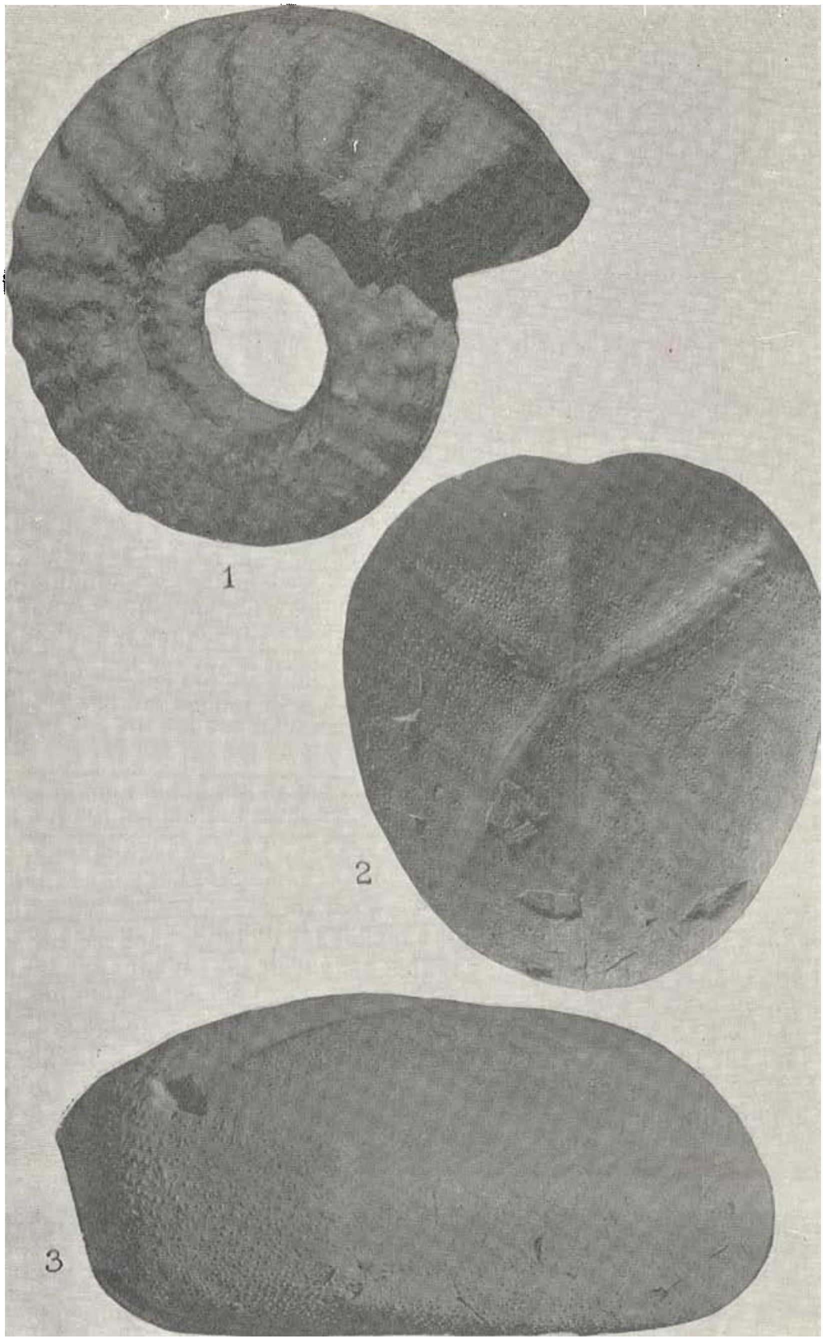
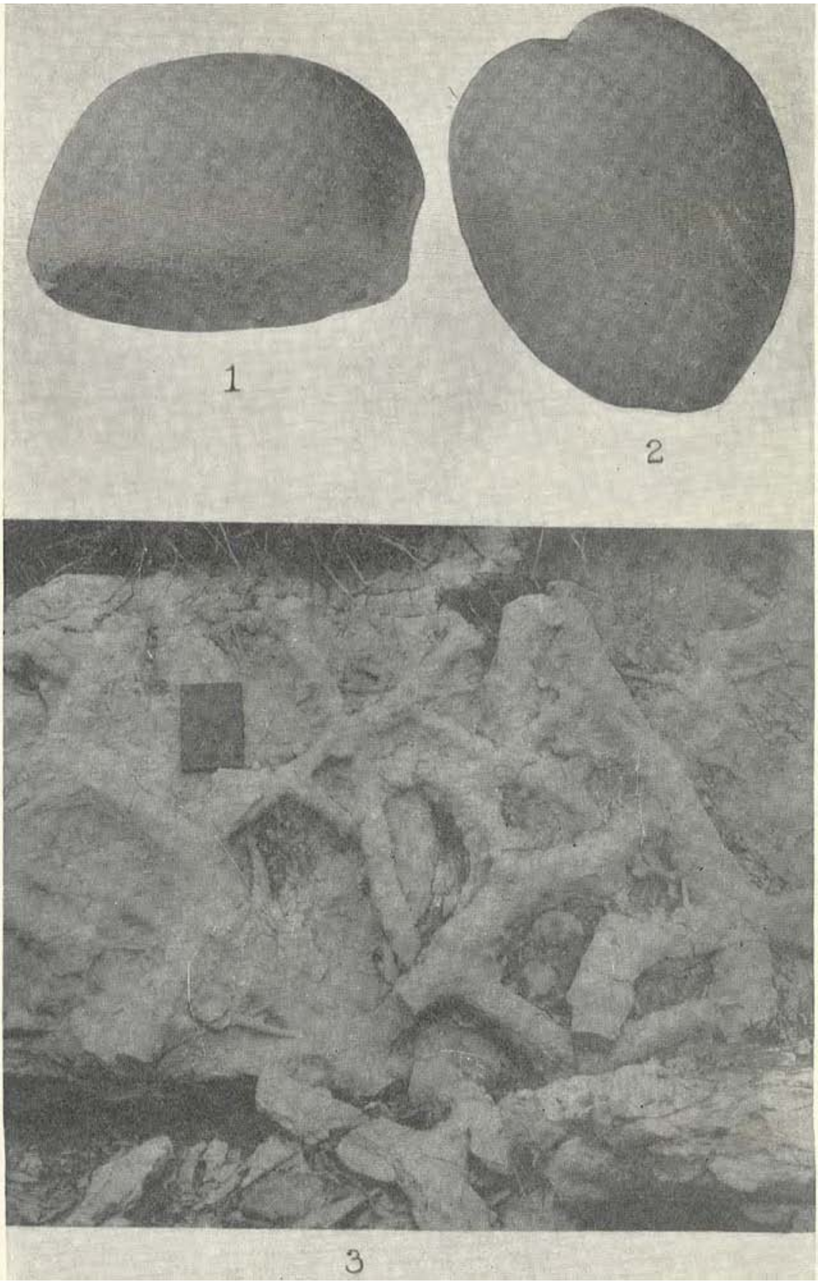

1
2
3

Plate VI

Figs. 1–2. *Holaster simplex* Shumard; horizon, Fort Worth limestone; size, natural.

Fig. 3. Fossil *Fucoids(?)* on the under side of a slab of Fort Worth limestone.

(Photograph through courtesy of the United States Geological Survey.)



1 2 3

Plate VII

Figs. 1–6. Plates and spines of an *Echinoid,* probably *Leiocidaris hemigranosus* (Shumard); horizon, Denton-Weno contact; size, natural.

Fig. 7. *Ostrea carinata* Lamarck; horizon, Denton-Weno contact; size, natural.

Figs. 8–9. *Ostrea quadruplicata* Shumard; horizon, ranges throughout the upper half of the Washita group especially abundant in the "Quarry" limestone at the top of the Weno clay member; size, natural.

Figs. 10–11. *Gryphea washitaensis* Hill; horizon, abundant at the top of the Fort Worth limestone and in the Denton-Weno contact zone; size, natural.

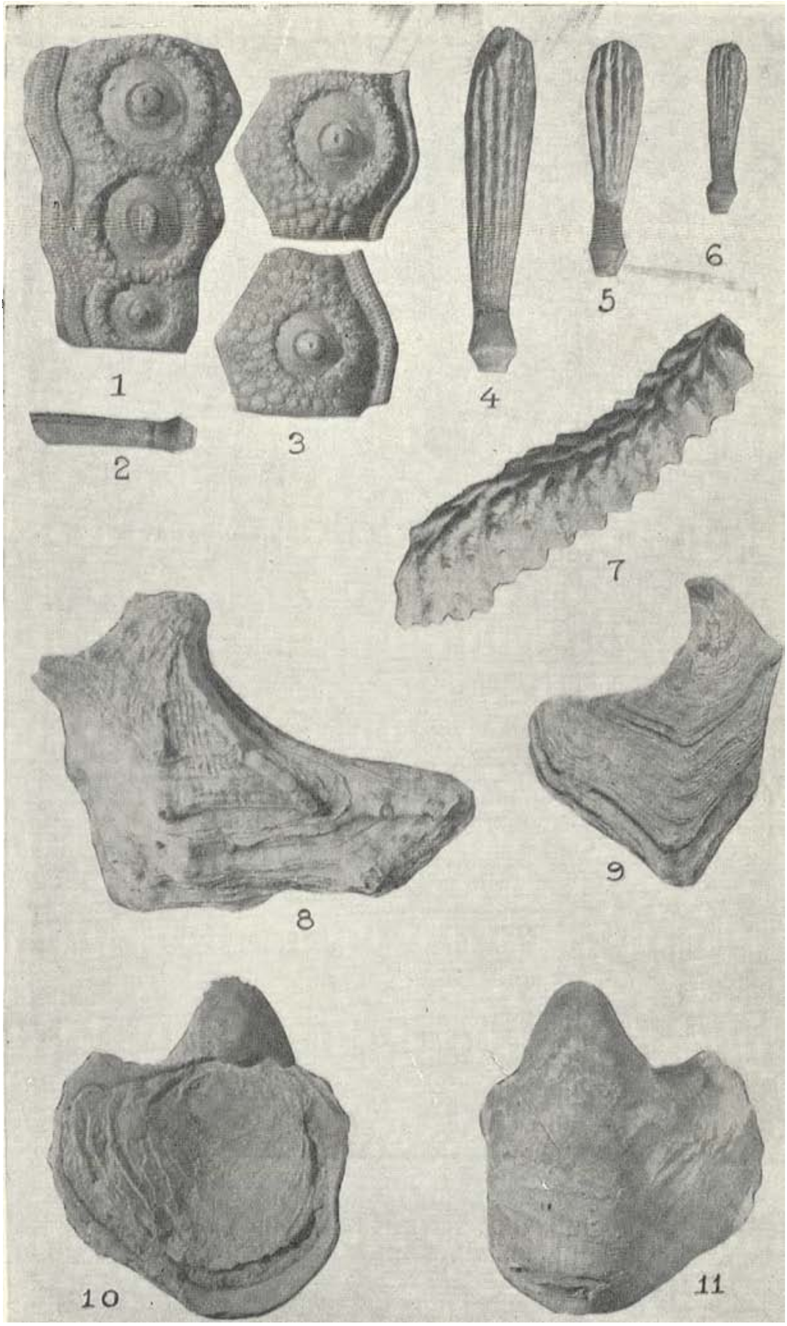

1
2
3
4
5
6
7
8
9
10
11

Plate VIII

Figs. 1–3. *Exogyra arietina* Roemer; horizon, abundant, upper Main Street limestone and lower Grayson marl; size, natural.

Figs. 4–5. *Kingena wacoensis* (Roemer); horizon, lower Main Street limestone; size, natural.

Figs. 6–7. *Gryphea mucronata* Gabb; horizon, abundant near the middle of the Grayson marl; size, natural.

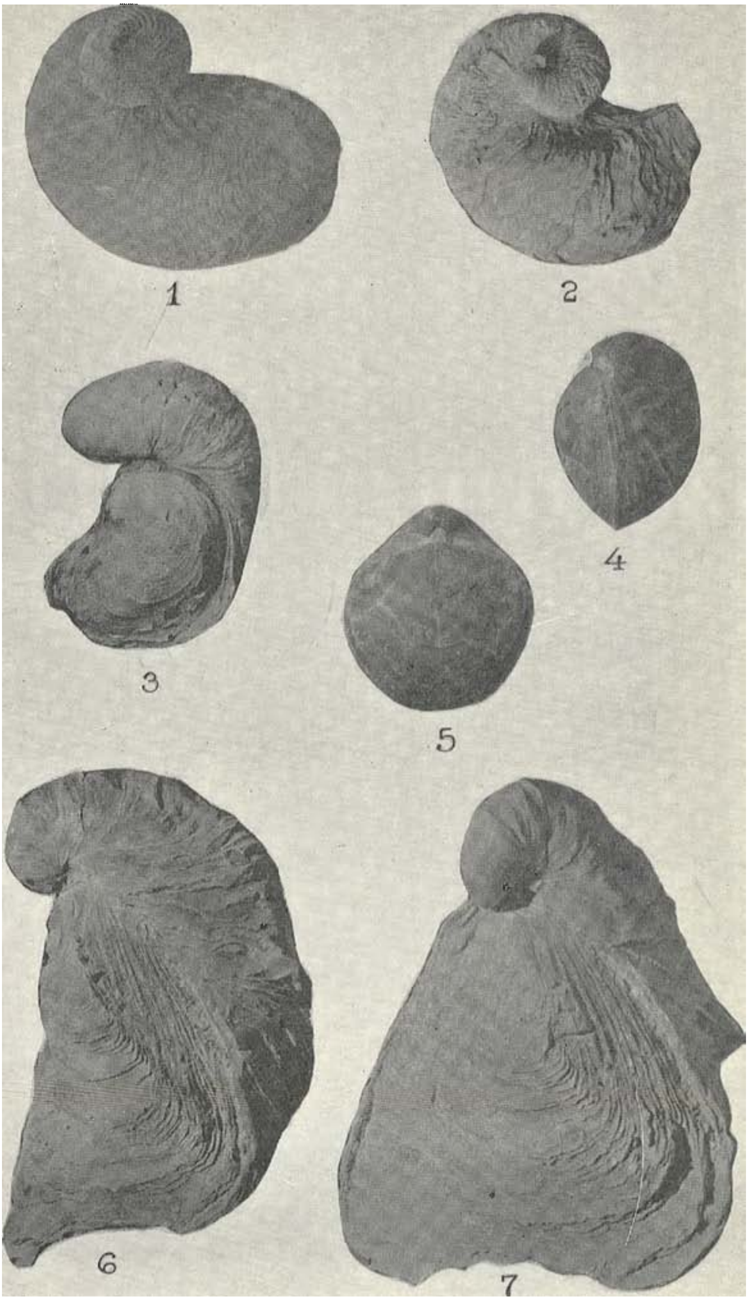

1
2
3
4
5
6
7

Plate IX

Fig. 1. *Ostrea carinata* Lamarck; horizon, Denton-Weno contact; size, natural.

Fig. 2. *Gryphea mucronata* Gabb; horizon, Grayson marl; size, natural.

Fig. 3. *Turrilites brazoensis* Roemer; horizon, Grayson marl; size, $\times$ 0.5.

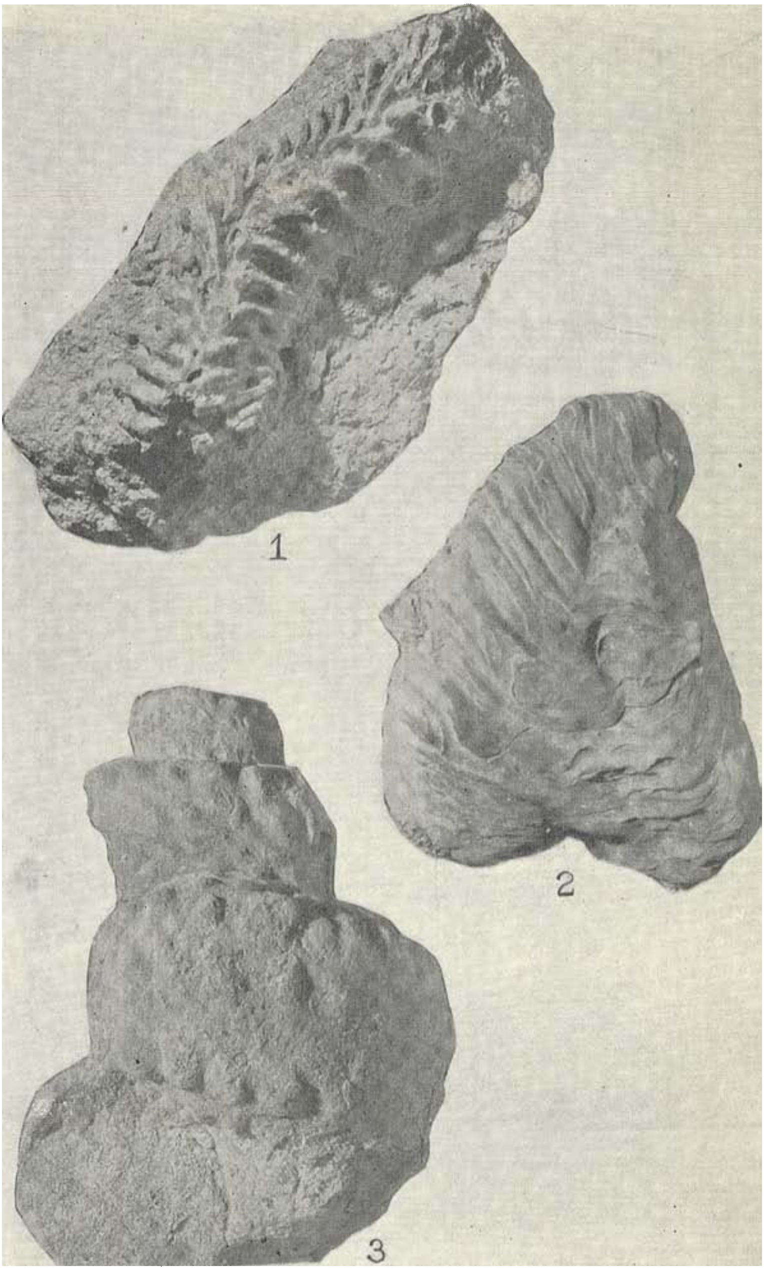
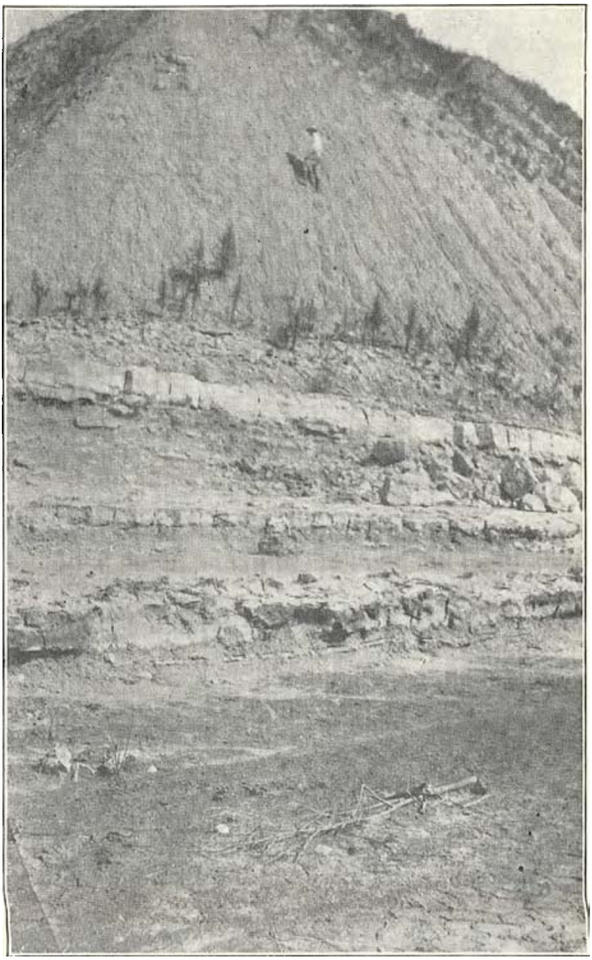
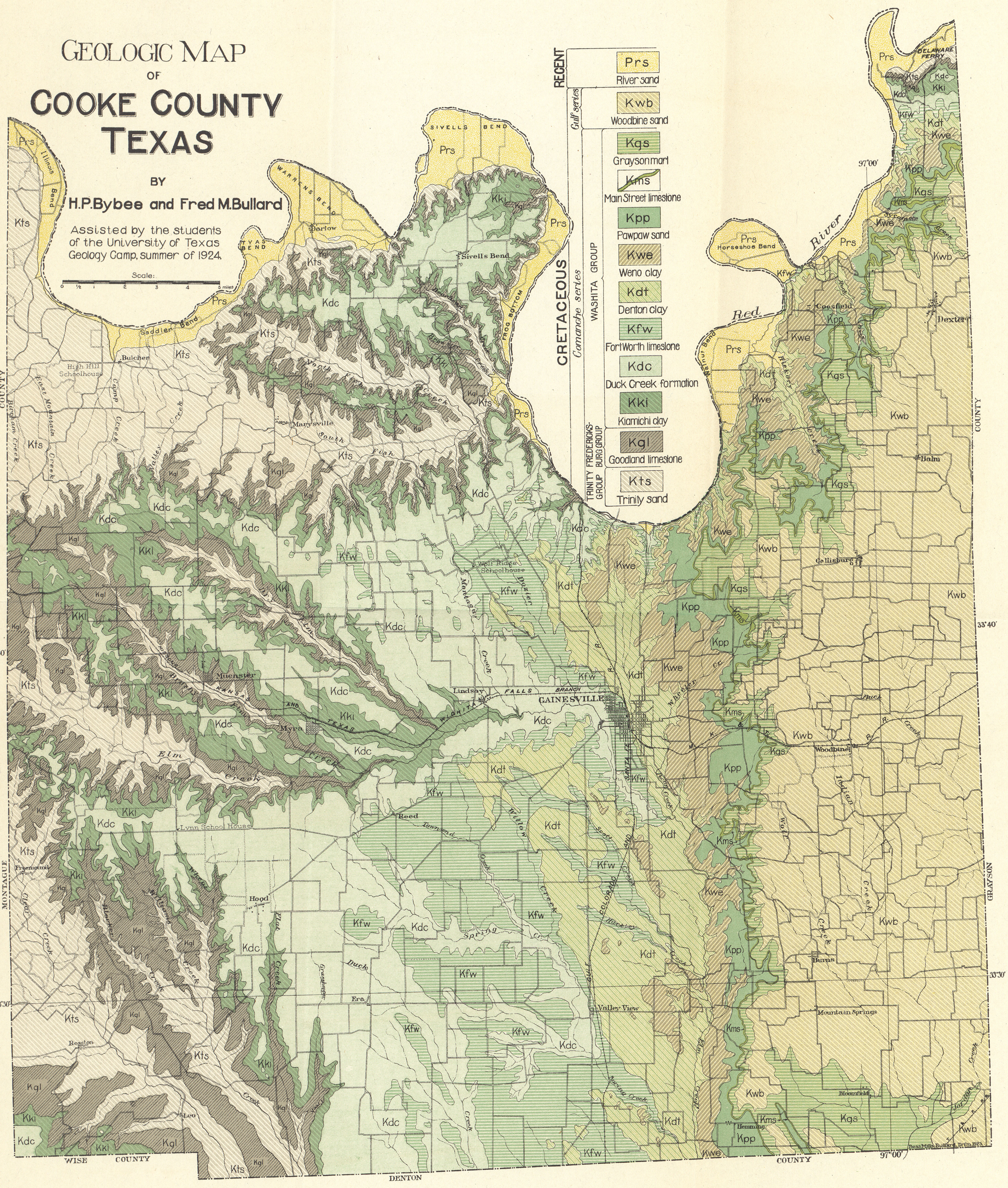

1
2
3

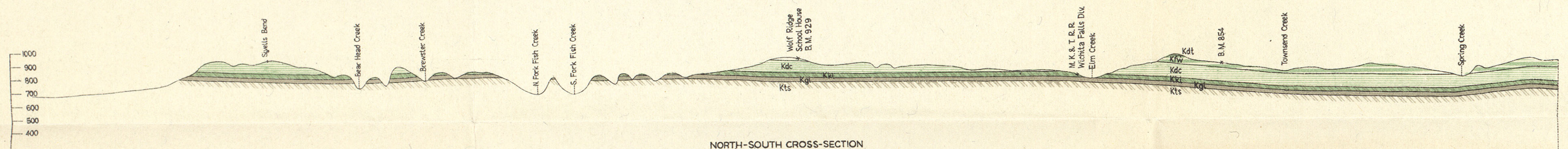
Plate X

Complete section of the Duck Creek formation exposed on the Oklahoma side of Red River, west side of Horseshoe Bend, northeast of Gainesville.

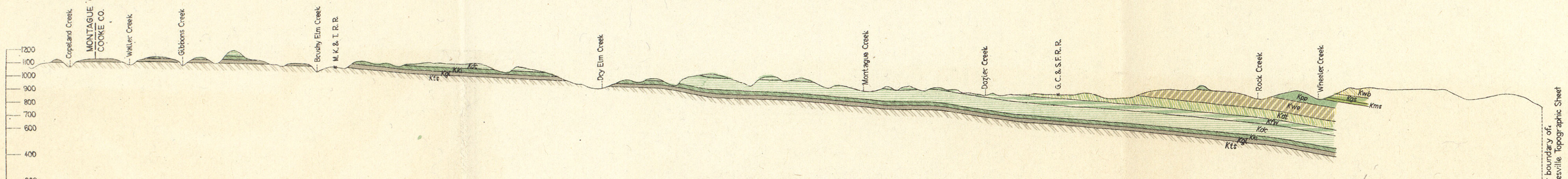


INDEX

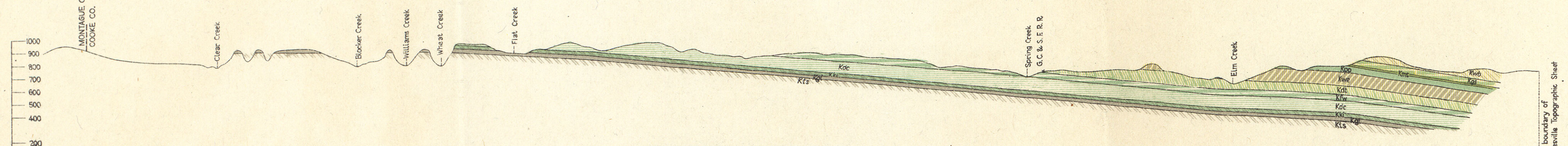




NORTH-SOUTH CROSS-SECTION THROUGH SIVELLS BEND



CROSS-SECTION ALONG 33°40' PARALLEL



CROSS-SECTION ALONG 33°30' PARALLEL

A. Hoen & Co. Baltimore Md.